THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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MUNICIPAL TRADING.

THE Joint Committee of the Lords and Commons was re-appointed to "report as to the principles which should govern powers given by Bills and Provisional Orders to municipal and other local authorities for industrial enterprise within or without the area of their jurisdiction."

The result of the inquiry proves what an error was made in stopping the work of the former Committee—before it had time to complete its investigations—for the report of the present Committee, which we reproduce elsewhere in this issue, confesses that, even now, "any attempt to survey the general subject of municipal trading could only have led to a second postponement of the inquiry."

Some useful evidence has been taken, resulting in the recommendations relative to the audit of accounts to which we briefly referred last week, but as the Committee report, "in consequence, however, of the great extent of ground to be covered, and the complexity of the subject," they were "unable to make any report on the merits, but confined themselves to a recommendation of re-appointment in the next session."

In dealing with municipal accounts the Committee have done excellent service in directing public attention to the defective systems, under cover of which reckless municipal traders have so frequently misled the ratepayers as to the actual commercial results of the attempts to substitute trading by local authorities for that private enterprise upon which the prosperity of the country depends.

As the Committee point out, "ratepayers should be not less fully and continuously informed of the success or failure of each undertaking than if they were shareholders in an ordinary trading company"; and the Committee add that in a "very large number of cases this is undoubtedly done. But there is some evidence to a contrary effect, and in view of the ever-increasing number and magnitude of municipal undertakings, it is most desirable that a high and uniform standard of account-keeping should prevail throughout the country."

We have long and consistently advocated the necessity for uniformity in the keeping of municipal electricity supply accounts, and are glad to find that the Committee recommend for the attainment of this object "that the Local Government Board should invite the Institute of Chartered Accountants, the Incorporated Society of Accountants and Auditors, and the Institute of Municipal Treasurers and Accountants of England and Wales, to confer and report upon the possibility of approaching a uniformity of practice in this matter."

The question of audit has been exhaustively considered, and the Committee declare that "it is desirable that a uniform system of audit should be applied to all the major local authorities.

The existing condition of the audit is described in a way

which should open the eyes of the ratepayers to the necessity of the reforms suggested, and to the danger of accepting the optimistic statements of municipal traders as to the alleged profits in relief of the rates.

Clause 13 of the Committee's report states that: "The evidence went to show that no effective system of audit is thus supplied. The elective auditors are poorly paid, or are unpaid altogether, little interest is taken in their election, and although in some cases they are able to lay a finger on a particular scandal, it is not clear that they could not make the same discovery in the capacity of active ratepayers. No complete or continuous audit is ever attempted by them."

This must be unpleasant reading for those who have abused all who have objected to the system so drastically condemned by the Committee.

The question of depreciation, of course, claimed considerable attention, and it is satisfactory to find in Clause 19 of the report, a recommendation that "Auditors should be required to express an opinion upon the allocation of sums of money to particular accounts, having special regard to the adequacy of reserve funds, and of amounts set aside to meet depreciation and obsolescence of plant in addition to the statutory sinking funds."

We are not surprised to find that the *Municipal Journal* and other organs of the Socialist party take alarm at such a proposal, and declare that "Municipalities must resist this dangerous financial censorship of the Local Government Board, which, if exercised to the full extreme, would seriously affect municipal industrial enterprise."

This is a tolerably strong admission that if municipal trading were subjected to the sound system of accountancy recommended by the Joint Select Committee, it would "Jeopardise municipal undertakings;" that is to say, that the ratepayers would discover that they had been living in a fool's paradise by believing that whether sound or not in principle, the trading was commercially successful and relieved the rates.

In many cases contributions are made to the rates, although actual loss upon the trading would be shown if the accounts were made up upon the principles suggested by the Committee's report.

In the report for the City of Liverpool recently presented by the Lord Mayor's auditor and the elective auditor, the engineer stated that "the depreciation on mains was very slow, and that it was more than provided for by the sinking fund."

The capital expenditure on the Liverpool undertaking is about £1,336,709, the depreciation upon which at 3 per cent. would amount to £40,101; but the amount transferred during the year for reserve and renewals was only £21,386 9s. 8d., and yet £12,029 figures as a contribution to rates.

The amount of the loans repayable as to £1,000,000 at 25 years, and £500,000 at 42 years, is represented by assets valued at £930,805 12s. 5d.

It seems difficult to understand by such figures how any contribution to rates is justified. In any case, it would be interesting to have a complete statement of the results of the working of the municipal undertaking made out upon the principles recommended by the Joint Committee. The ratepayers of Liverpool would then understand what municipal trading in electricity supply has cost them.

Liverpool has the largest trade of any municipal electric supply business, with an excellent load factor (25·11), considerably better than that of any other electric undertaking, whether local authority or company, and a charge for the public lighting which shows a large profit over total costs.

The difference between the capital expenditure and estimated value of the assets appears to be £544,973, while the total amount to the credit of the sinking fund is £83,243 19s. 0d., or a deficiency of £461,730, less the amount of reserve and renewal account, which in the last year figures for £21,386 9s. 8d.

The Committee recommend the creation of a new body in the form of a Board of Commissioners of Local Audit, on similar lines to the Railway Commission.

It is obvious that the last recommendation of the Committee should be adopted, viz., the continuance of the investigation into the other branches of the subject of municipal trading.

The importance of the matter cannot be overstated, and although to a certain extent the evil is curing itself by the awakening of the ratepayers to the serious position in which they are being placed by an unprofitable system of trading opposed to all sound principles, legislative interference is absolutely necessary to limit and control the progress of Socialism.

It is, perhaps, fortunate for the community that the floating of municipal loans is becoming more and more difficult. In October last we directed attention to the question of the security for the enormous amount of money which Local Authorities were borrowing, and showed that a time would come when "the length of the tether" would be reached. The time appears to have already arrived, when municipal borrowers find it difficult to float their loans, and the public do not subscribe one-tenth of the issues. This is a serious matter, because it may interfere with raising money for legitimate municipal enterprise, apart from speculative trading, and thus retard improvements necessary for the prosperity of our towns and cities.

The Workmen's Compensation Act.

THE cases arising under this Act seem to trend in the direction of making the employer an absolute insurer of his workman in all circumstances. At first it was supposed that the bad draughtsmanship which characterised the measure left a number of loopholes of escape; but these have one by one been closed up by the House of Lords. Their most recent exploit is to give a wide definition of the term "accident," which, as our readers are doubtless aware, is the starting point of every claim.

It appeared that a workman was employed to work a machine for cooking and pressing into shape cattle cake. He failed to move a wheel, which had apparently become jammed. Having obtained assistance he tried again, and in consequence of the strain he said that he felt a pain in his stomach. Later on, he found he had sustained a rupture, for which he was treated in the hospital. In answer to a claim for compensation under the Act of 1897, the employers contended that there had been no accident within the meaning of the Act, and that they were not liable. The County Court Judge found as a fact that there had not been an accident, and his judgment was upheld in the Court of Appeal. The House of Lords, however, have over-ruled the Court of Appeal, and have sent the case back to the County Court. Assuming the absolute truth of the facts to be as above stated, it must be admitted that the injury was the result of an accident. In the course of his judgment, Lord Macnaghten said: "If a man in lifting a weight, or trying to move something not easily moved, were to strain a muscle, or rick his back, or rupture himself, the mishap, in ordinary parlance, would be described as an accident." In commenting upon certain recent decisions in the Court of Appeal, his Lordship said: "If a man injures himself suddenly and unexpectedly by throwing all his might, and all his strength, and all his energy into his work, by doing his very best and utmost for his employer, not sparing himself or taking thought of what might come upon him, is he then to be told that his case is outside the Act because he exerted himself deliberately, and there was an entire lack of the fortuitous element? I do not think that, if such were held to be the true construction of the Act, the result would be for the good of the men or for the good of the employers in the long run." Cordial agreement with this statement of the law does not conflict with our view that the case under review was incorrectly decided. Times and again it has been laid down that upon every question of fact, the finding of the County Court judge is final, and binding upon the parties. Too often has this absolute jurisdiction seemed to press hardly upon employers; it is, to say the least, unfortunate, that when employers have gained the day on what is a mere question of fact, the decision should be disturbed in a higher court. The case under notice, and the statement of law made by Lord Macnaghten, clearly show how important it is to give the County Court judge an absolute discretion. A man may be ruptured at any time, away from his work.

What would be easier than for him to allege and prove that the damage was sustained in the course of his employment? The County Court judge has the advantage of hearing the applicant, and the witnesses who give evidence in support of his case; he, and he alone, has an opportunity of detecting the perpetration of a fraud. Is he not, in these circumstances, the best judge of the facts?

One or two cases already decided, show that the County Court judges are not slow to make awards in favour of workmen, when there has really been an accident. Thus in Timmins *v.* Leeds Forge, a man was employed in moving heavy planks from one pile to another. During the night the planks were all frozen together so that there was some difficulty in separating them. The lower planks were more firmly stuck together than those above, but the man was not aware of this. The man sustained an injury owing to the difficulty of moving one of the lower planks; and it was decided by the County Court judge that there was evidence of an accident.

Pro bono publico.

Mr. Andrew Carnegie's latest benefaction is a gift of half a million sterling to his native town of Dunfermline. To this one can make no demur; how much he has already expended on free libraries we do not know, but that much of his wealth has been frittered away on this fad, which with him seems to have grown into a perfect mania, is patent to everyone.

In discussing the physical condition of the British race last week, we humbly suggested to our would-be philanthropists that there are methods without number for applying their money, methods better than that of founding free libraries for the subsidising of the gutter press. We then enumerated a few directions in which the surplus cash of a multi-millionaire could be well directed, and to-day we add yet another which seems to have been hitherto unnoticed, although to small country towns and villages it is of far greater importance than the establishment of free reading rooms. This is nothing more nor less than the plentiful supply of water to the community.

We have in mind a parish in the Cotswolds, with a poor class population numbering well on towards 1,000 souls, and where the only water obtainable, beyond the contents of the few and far between garden wells, into which sewage usually percolates, is from five spouts in the side of a churchyard bank, which after days of heavy rain flow freely, but in dry seasons are almost devoid of what is, perhaps, the greatest necessity of life. These spouts project from a small structure of ornamental masonry, and the spot, almost the lowest point in the village, is—facetiously, we presume—termed "The Wells." A few yards further along, two more small spouts dribble into what were once two stone horse-troughs, now knocked into one. Here comes the bulk of the villagers for their daily supply of water both for potable and cleansing purposes; here, too, many of the farmers have to send men and horses to fill and cart away barrels of water for their stock to distances of one or more miles, because of the absence of ponds or streams in this hilly locality.

There are many such practically waterless districts in the hilly parts of this country, and the vital needs of the people inhabiting such localities could be provided at far less expense than is incurred in establishing many a costly, and, for all educational purposes, useless free library. A self-acting hydraulic ram which can be obtained in sizes to raise from 300 to 400,000 gallons per day, and which will force to a height of 800 feet where necessary, a small reservoir in the upper part of the village, and a few stand pipes at the corners of streets, and the thing is done. These pumps work night and day, and can raise water from a stream falling a few feet to almost any height and distance; indeed, the fall may vary from 18 in. to 100 ft., but, naturally, the greater the fall the more powerful will be the machine.

We commend the notion to Mr. Carnegie, and if it impresses him favourably we hope that this and other parishes, equally unfortunate, may benefit from his unstinted generosity in the cause of good, albeit it now seems misdirected in certain quarters.

HIGH TENSION CABLES AND OVERHEAD TRANSMISSION.

By Charles C. Garrard.

Accustomed, as we are in England, to the usual winter general breakdown of the telegraphic service with the first heavy fall of snow, one reads with some astonishment, not unmixed with amusement, certain remarks recently contained in the American *Electrical World*, as to the special precautions required to be taken with underground transmission (as against overhead) in order to guard against faults and interruptions of supply. The above-mentioned annual breakdown of the telegraphic service is generally adduced by the advocates of underground cable transmission as an example of what would occur if, in England, overhead transmission of electrical energy were common. This argument is, however, a fallacy. The breakdown of the telegraph wires is the direct result of non-attention to proper construction, and the allowance of a too low factor of safety in the general design. There is now no doubt that by attention to the engineering details, an overhead transmission line can be made as mechanically perfect as an underground line, and able to withstand any stress due to the severest weather.

As regards insulation, America has led the way in the manufacture of line insulators of porcelain and glass which to-day leave little to be desired both electrically and mechanically. Up to the present time it has not been possible to get good electrical porcelain from any English pottery. Good electrical porcelain must be of a vitreous character, that is to say, when broken it must have a shiney fracture, and must be totally non-absorbent of moisture. This character results if the raw material contains a constituent of low melting point mixed with a larger percentage of a substance of higher melting point. This latter, during the baking, simply "sinters," whereas the former entirely melts and gives the whole a glass-like texture, in that each small particle of the higher fusing substance is contained in a shell of melted material, and held by the same to the next particle of the higher melting constituent. Such a raw material is either found as such or is obtained by mixing the constituents in the requisite proportions. The English clays as found are not suitable for the production of vitreous porcelain, and the art of mixing to give good electrical properties to the finished article has not yet been learned by the English potter.

English porcelain, as yet made, depends for its insulating properties almost entirely on the glaze. The glaze is simply a thin outside layer of vitreous porcelain got by painting the baked biscuit ware with a coating of a flux and refiring. Sometimes with the cheaper class of goods the glaze is put on without taking the articles out of the baking kiln, by throwing, at the end of the baking, the flux into the fire, when it vaporises and combines with the outside layer of the articles.

Such glazed porcelain, non-vitreous inside, if kept dry, gives good enough insulation for indoor work, say, up to 3,000 volts working pressure. For outside work and anywhere where it is liable to get damp it is of no use. The glazing of the porcelain should, however, never be omitted, whether the material be vitreous or not, as it gives a very good dead smooth surface to which dirt cannot stick.

We have had as yet in England no demand for high tension insulators for outdoor service. Should the legal or other difficulties which at present stand in the way of overhead transmission be removed, the use of higher voltages than at present used will, there can be no doubt, become economical.

It has been alleged by some that the English climate is not suitable for overhead transmission. This is not right, for though, no doubt, insulators with larger leakage paths, &c., will be required here than in the drier atmosphere of America, there is absolutely no doubt that china or glass insulators could be constructed which would be satisfactory, even under the worst atmospheric conditions. In this case it will behove our potters to wake up and discard their rule of thumb methods, if we are to be independent of the Americans in this matter.

There are two other points of view from which it is of advantage to compare overhead and under-

ground transmission :— (1) Lightning dangers ; (2) Liability of breakdown due to bad electrical conditions in the circuit (resonance, &c.). As far as No. 1 is concerned, we in England are decidedly better off, in any case than the Americans, as thunderstorms and lightning dangers are comparatively rare in England. At first sight it would seem that an underground cable is entirely free from any danger due to lightning. This does not appear to be the case, as in 1898 three submarine mines near Hampton Roads were exploded by lightning during a single thunderstorm. Of course the conditions are not quite parallel, but while underground lines are surely safer from certain kinds of lightning effects than overhead lines, it is not safe to assume that there is complete security. As regards lightning arresters, very much remains to be done.

The breakdown which happened at Niagara some short time ago, if it were really caused by lightning, is a glaring example of the inefficiency of present-day types. It is probable that all spark-gap arresters are unsatisfactory, and that the only really safe method is to permanently connect the line to earth through a non-inductive resistance. This method is already in use in several places, notably at the Valtellina Railway, where the non-inductive resistance is made by three water jets from earthed nozzles playing against cup-shaped receptacles connected to each phase. The efficiency of this method, while no doubt always good, varies inversely as the value of the non-inductive resistance ; it follows that the protection is only got by the expenditure of a certain amount of energy. The determination of the right amount of energy to expend in consideration of the requisite safety can only be made in each particular case. It is certain, however, that any attempt (such as has been proposed) to connect the arrester to the line only when the atmospheric conditions are threatening will eventually lead to disaster, as it is quite impossible for the engineers at the generating station to know exactly what is occurring all along the line ; and besides, one has to reckon with the, one might almost say, certainty, that the arrester will fail to be put on one day, when it should have been, and that consequently an accident will result.

As regards resonance, there is no doubt that this is a real danger, though it does not seem to be by any means confined to underground cables.

The subject of electrical resonance in power work is one which lends itself to a very beautiful theoretical treatment, which treatment, however, though, no doubt, extremely helpful to those engineers who have sufficient leisure to master it, does not seem to lead to much practical result. What experimental evidence has been published is of a somewhat contradictory nature. We believe we are correct in saying, however, that many somewhat startling results have been obtained and experience gained by several supply authorities in England, which, if published and submitted to criticism, would go a long way to putting this matter on a correct footing.

A policy of concealment is unfortunately followed, with the result that the manufacturers, from whom the practical improvements in commercial apparatus must eventually come, are working in the dark. A closer connection and more ample interchange of ideas between the supply authorities and the manufacturers are consummations earnestly to be desired in England.

There can be no doubt that the great progress in electrical engineering which has taken place in Germany, for example, is due to a great extent to the fact that many of the big firms there have combined the business of manufacturing with the public supply of electrical energy, and have thus been enabled to get results as to the practical operation of their manufactures, which would have been quite impossible if their responsibility ended when the plant went out of their works' test rooms.

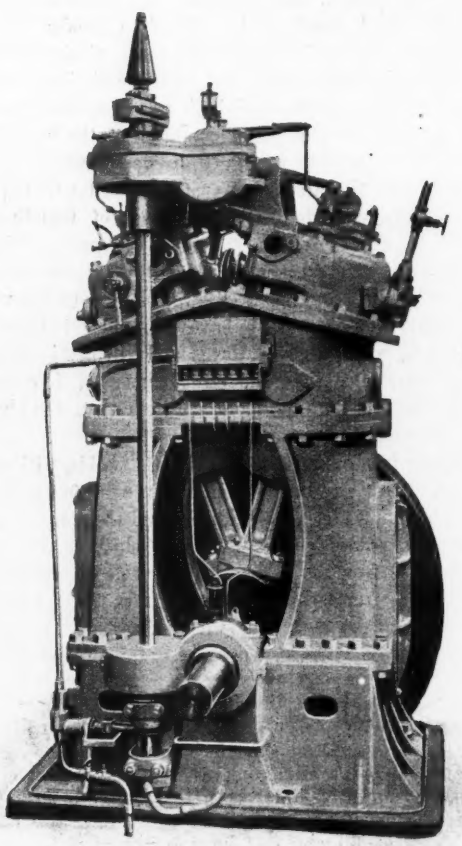
As regards the means to be adopted to guard against the bad effects of resonance and current surgings, that arrangement which would form an efficient lightning protection would also protect against these. The primary object to be sought after is, of course, to so design the installation that resonance cannot be set up, or at any rate, will be reduced to a minimum. To guard against imperfection in the system, and accidents, the non-inductive resistance suitably connected, will, no doubt, be most efficient, and it would pay designers to give attention to this subject so that an article may be produced which would fulfil all the necessary conditions.

THE GAS ENGINE AND ITS FUTURE.

(*Continued from page* 242.)

The Crossley Gas Engine.

Seeing that, from 1898 to the end of last year, Messrs. Crossley Bros., Ltd., of Manchester, supplied no less than 1,563 gas engines for electric lighting purposes, varying in size from 2½ to 500 H.P., with a total power amounting in the aggregate to over 48,000 H.P. (average 31 H.P.), it will be interesting to examine into the type of machine which they, with their extended experience, now offer for employment in large power stations. From the illustrations it will be noticed that they have not considered it necessary to depart from the single-acting four-cycle Otto type of cylinder, with side shaft driven by skew or worm gearing, and tube ignition.



Vertical Two-Cylinder Crossley Engine.

For engines above 300 H.P. all parts coming in contact with the heat of the explosion of the charge of gas and air are water-cooled, including the piston and exhaust valve. Governing on these large engines is on the graduated cut-off system, altering the mixture of the charges in proportion to the work done.

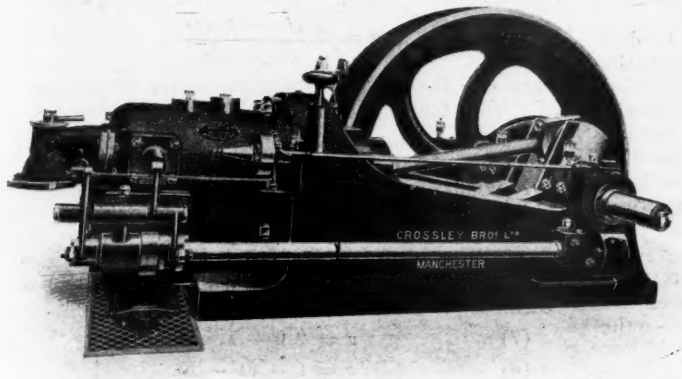
A single heavy fly-wheel is employed to secure the minimum cyclic irregularity, storage of energy being provided by the heavy rim. For engines making long runs continuous lubrication is provided.

For large power stations they recommend producer gas, or if situated near blast furnaces the gas otherwise wasted, can, after purification, be employed with advantage for driving the engines.

All moving parts are carefully counterbalanced, and the engines are specially constructed with a view to eliminating the risk of premature ignition.

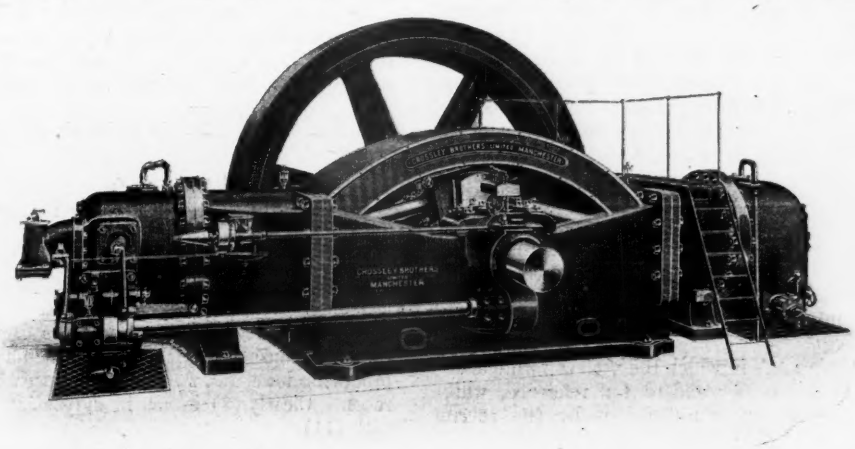
To reduce the noise of the exhaust, silencers of various kinds are used.

Above 150 H.P. and up to 500 H.P. two cylinders are generally advised, one on either side of the crankshaft, and for still larger units four cylinders, two on each side of the main shaft, giving two impulses every revolution.



High Speed Crossley Engine, 41—150 B.H.P., New Design for Electric Lighting.

In order to economise space as much as possible, dynamos can either be coupled direct to the engine crankshaft, or can be built on the fly-wheel; four engines so arranged are said to give great satisfaction.



Double Cylinder Crossley Engine.

The consumption of coal gas is given as 15 cb. ft. per B.H.P. per hour, and with producer gas the consumption would be from 60 to 80 cb. ft., according to the quality of the gas.

For electric lighting purposes the engines are fitted with a duplicate-timed igniter, so that in the event of one of the ignition tubes breaking, the engine is not stopped, as it continues to run with the spare tube, and the attendant can in the meantime replace the broken one. This gives perfect security against stoppages, and is, as need hardly be pointed out, a necessity in the case of engines for electric lighting purposes.

Up to the present, the largest cylinder made by this firm is 31 in. in diameter, with a stroke of 36 in., while the maximum piston speed is 900 ft. per minute.

The accompanying figures show the newest designs of large power gas engines manufactured by Messrs. Crossley Bros., several of which are working, including six of 500 H.P.

The Körting Type.

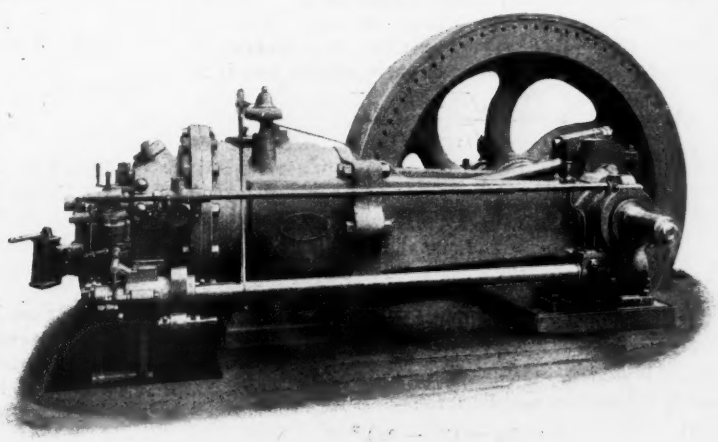
We have referred to the type of engine manufactured by Gebr. Körting, Maschinenbau Aktien-Gesellschaft, as being the highest average power unit up to the present. This type of engine differs considerably from those of Messrs. Crossley Bros. and Messrs. Cockerill, in that it is two-cycle, whereas theirs are four-cycle.

For the manufacture of this class of engine in this country, Messrs. Mather & Platt, Ltd., have entered into an arrangement, after making a thorough investigation into its suitability for the driving of electric generators, and in conjunction with their dynamo department, they have placed themselves in a position to offer combined sets of any size demanded.

The Körting engine has already been built to develop 700 B.H.P. in a single cylinder, and engines are now in course of construction developing 1,000 and 1,200 B.H.P. in this manner.

Besides being of the two-cycle type, the Körting engine is made double-acting, being therefore exactly on the same lines as an ordinary double-acting steam engine. Each side of the piston receives an impulse every alternate stroke, *i.e.*, there are two impulses per revolution, or four times as many as in the single-cylinder "Otto" cycle engine. The perfection of the stuffing box, by water cooling and metallic packing, has rendered this type of engine possible.

To allow of the "double-acting" "two-cycle" method, it is necessary to provide two charging pumps, one for air and one for gas; this, while removing the necessity of an exhaust valve, subject to intense heat and considerable pressure, by the use of ports uncovered by the piston, requires other valves in connection with the gas and air pumps.



Crossley Engine for Electric Lighting, 90—127 B.H.P.

(To be continued.)

TESTS ON BROKEN CABLES—SOME INCONSISTENCIES IN LOCALISATION FORMULÆ.

NOTE BY E. RAYMOND-BARKER.

THE following "Note" has been written, first, to draw attention to various inconsistencies in text-book localisation formulæ: secondly, to summarise in uniform consistent algebraic symbols, the several formulæ—whether calculated or empiric—which, since the enunciation of the Kennelly law some 15 years ago, have from time to time appeared.

Certain men of responsible and honorable position in the cable service have, from time to time, recorded in text-book form the results of their experience. In this manner much valuable information and many interesting data have been placed at the disposal of cable men in various parts of the world, who have thereby been enabled to easily acquire a more intimate knowledge of cable electro-technics than—owing to want of time due to pressure of office duties—would have been possible had these men been left to their own unassisted efforts.

Owing, may-be, to some difficulty in the matter of correcting proofs—perhaps when the author has been thousands of miles distant from the publisher—certain errors have undoubtedly crept into pages otherwise replete with information useful to the aspirant, and interesting to all.

Thanks to the use, for years past, by the writer, of a rigidly consistent and unvarying system of symbols, his cursory perusal of different text-books on their first appearance failed to bring about the discovery of the afore-mentioned inconsistencies, some of nearly ten years' standing. Only very recently did mere chance reveal a certain mistake in print, which led to a close comparison of the different books. Naturally a preliminary perusal of a new book is followed up by closer study of important new matter, whereas a slip in an elaborate formula embodying a well-known law may for years escape detection.

By way of some tribute of recognition for the useful work so well carried out by the various text-book authors, also for the sake of cable students whom this matter may interest, the writer will proceed to give confirmatory evidence of the facts above-stated.

Kempe's "Handbook," in which the various formulæ are correct, has been taken as standard for reference, whilst three other text-books are considered under the several headings "A," "B," "C."

Abbreviations :—F.Z. = False or cable zero.
S.Z. = Scale or true zero.
Res. = Resistance.
Br. Rdg. = Bridge reading.
E.C. = Earth current.

Standard of reference :—Kempe, sixth edition. Kempe's formula for res. of cable up to break, on basis of Kennelly's law, viz., that res. of copper exposure of a broken cable varies inversely as the square root of the current passing :—

$$(1) \qquad x = \frac{R_1\sqrt{c_1} - R_2\sqrt{c_2}}{\sqrt{c_1} - \sqrt{c_2}},$$

where R_1 and R_2 = total measured res. when respective currents c_1 and c_2 are passing. Clearly c_1 is here taken as symbol for the higher current productive of R_1 the lower res., whilst c_2 is the lower current producing R_2 the higher res.

Kempe's simplification of (1) :—

$$(2) \quad x = R_1 - (R_2 - R_1)\frac{1}{\sqrt{n} - 1}, \text{ where } n = \frac{c_1}{c_2}.$$

Then, if relative strengths of c_1 and c_2 are 4 : 1, that is, if $n = 4$, (2) becomes simplified to :—

$$(3) \qquad x = R_1 - (R_2 - R_1).^*$$

$$(4) \qquad x = 2R_1 - R_2.^\dagger$$

Kempe's formula on basis of Schaefer's law :—

$$(5) \quad x = R_1 - (R_2 - R_1)\frac{1}{\sqrt[1.8]{n} - 1} \pm \left[\begin{array}{c}\text{Usual Schaefer cor-}\\ \text{rection for E.C.}\end{array}\right]$$

* First given by Mr. H. E. Cann, ELEC. REV., Oct. 4th, 1895.
† Pointed out by "W. J. M.," ELEC. REV., Oct. 11th, 1895.

The above expressions are all consistent, and may be taken as standards of comparison for what follows.

Data as given in Text-book "A."

Kempe's formula embodying Kennelly's law is given as—

$$(6) \qquad x = \frac{A\sqrt{c} - B\sqrt{c_1}}{\sqrt{c} - \sqrt{c_1}}.$$

Here c = the higher current producing the lower res. A.
c_1 = the lower current producing the higher res. B.

The author refers to the convenience of using currents in the proportion of 1 to 4.

Naturally one expects the value 4 to be applied to c, hitherto the symbol for the higher of the two currents employed. In this case, with the proportion of 1 to 4, we should have $c = 4\ c_1$. Instead of this, the expression is given as $c_1 = 4\ c$, and the formulæ as printed in text-book "A":—

$$(7) \qquad x = 2B - A, \text{ and}$$

$$(8) \qquad x = B - (A - B),$$

instead of, as they should appear :—

$$(9) \qquad x = 2A - B,$$

$$(10) \qquad x = A - (B - A).$$

Expressions (9) and (10) are consistent with (6), whereas (7) and (8) are not so, for clearly in (6) $A < B$, whilst in (7) and (8) $A > B$.

In an appendix note in Text-book "A," after quoting the erroneous formula (7) $2B - A$ [correct only on the assumption that $c_1 = 4\ c$, which is not consistent with (6)], the writer harks back to the correct expression (6), viz., $x = \frac{A\sqrt{c} - B\sqrt{c_1}}{\sqrt{c} - \sqrt{c_1}}$, in which clearly $c > c_1$, whereas (7) is based on $c_1 = 4\ c$ or $c < c_1$.

The writer then gives a simplification of (6), viz. :—

$$(11) \qquad x = \frac{A - B\sqrt{\frac{c_1}{c}}}{1 - \sqrt{\frac{c_1}{c}}},$$

which is consistent with (6) in which c = higher current producing lower res. A, c_1 = lower current producing higher res. B. Clearly (7) is not in agreement either with (6) or with (11).

Data as given in Text-book "B."

A, B and C are results of tests "with 1, m, and n milliamperes to line."

1, m, n, are not milliamperes but ratios. If, *e.g.*, lowest current = 5 m.a., $m = 10$ m.a., and $n = 20$ m.a., 1, m, and n would be 1 : 2 : 4 for formula :—

$$(12) \quad x = \frac{(nc - A)(\sqrt{m} - 1) - (mB - A)(\sqrt{n} - 1)}{(n - 1)(\sqrt{m} - 1) - (m - 1)(\sqrt{n} - 1)}.$$

Here
A = highest res.
B = intermediate.
C = lowest res.

Then follows analysis of dual test conditions, ending up in the Kempe formula for Kennelly's law letter for letter, as in Text-book "A," viz. :—

$$(13) \qquad x = \frac{A\sqrt{c} - B\sqrt{c_1}}{\sqrt{c} - \sqrt{c_1}}.$$

Clearly, as before, $c > c_1$ and $A < B$, which condition of things, however, does not justify the statement in Text-book "B," that with currents in the ratio of 1 : 4, $x = 2B - A$. This, as has been already shown, should be $x = 2A - B$, which bears the same relationship to (13) as (4) does to (1).

Data as given in Text-book "C."

Kempe's formula for Kennelly's Law :—

$$(14) \qquad x = \frac{R_1\sqrt{c_1} - R_2\sqrt{c_2}}{\sqrt{c_1} - \sqrt{c_2}} \qquad \text{[Same as (1)].}$$

Here again c_1 must be the higher current producing the lower res. R_1, whilst c_2 is the lower current producing the higher res. R_2.

Yet Text-book "C" continues by stating that (14) may be put into more convenient shape for practical use, thus :—

$$(15) \qquad x = R_1 - d\frac{\sqrt{n}}{\sqrt{n}-1}$$

where $d = R_1 - R_2$, the difference between the res. readings, and $n = \frac{c_1}{c_2}$, the ratio of the currents.

Surely, according to (14), $d = R_2 - R_1$, and (15) should be altered to :—

$$(16) \qquad x = R_2 - d\frac{\sqrt{n}}{\sqrt{n}-1}, \text{ where } d = R_2 - R_1,$$

$$\text{and } n = \frac{c_1}{c_2}.$$

Similarly, the 1 : 4 method is given by Text-book "C" as $x = 2R_2 - R_1$, instead of $x = 2R_1 - R_2$ [Same as (4)].

Text book "C" states conditions for triple test thus :—

Let R_1, R_2, R_3, be the *true* zero balancing resistances, with an even bridge fork, and currents, c_1, c_2, c_3.

Then

$$(17) \quad x = \frac{(c_3, R_3 - R_1)(\sqrt{c_2}-1) - (c_2, R_2 - R_1)(\sqrt{c_3}-1)}{(c_3-1)(\sqrt{c_2}-1) - (c_2-1)(\sqrt{c_3}-1)},$$

which is similar to (12), though differing in nomenclature. This enunciation of test conditions might, with advantage, be made more clear, and the several symbols directly identified with the higher and lower resistances and currents involved. In any case, c_1, c_2, c_3, are not currents, but ratios of currents. If, for instance :—$c_1 = 25$ m.a., $c_2 = 12$ m.a., $c_3 = 5$ m.a., corresponding ratios $r_1 = 5$, $r_2 = 2{\cdot}4$, $r_3 = 1$, are to be substituted in (17), in place of c_1, c_2, c_3.

When describing the Schaefer test, Text-book "C" adopts a fresh nomenclature, viz. :—If $n\,c$ and c be currents to line when A_1 and B_1 are the balancing resistances,

$$(18) \quad x = B_1 - (B_1 - A_1)\,K_1 \mp \cdot \begin{pmatrix}\text{Schaefer correction}\\ \text{for E.C.}\end{pmatrix}$$

where $$K_1 = \frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n}-1}, \text{ and } n = \text{current ratio},$$

which is not quite so simple as the expression for the Schaefer test given by Kempe, which in this case would be

$$(19) \quad x = A_1 - (B_1 - A_1)\,k \mp \begin{pmatrix}\text{Schaefer correction}\\ \text{for E.C.}\end{pmatrix},$$

where $$k = \frac{1}{\sqrt[1\cdot3]{n}-1}, \text{ and } n = \text{ratio of currents.}$$

In the expression given by Text-book "C" for a triple test by the Schaefer law (an expression corresponding with (17) for the Kennelly law), a printer's error has caused $\sqrt[4\cdot3]{\ }$ to appear four times instead of $\sqrt[1\cdot3]{\ }$. In this expression n appears as representing a current, whilst on the following page the same symbol does duty for the ratio between two currents.

(To be continued.)

CARRIAGE OF MERCHANDISE ON ELECTRIC TRAMWAYS.

By THOMAS UPTON,

Goods Traffic Manager to the South Lancashire Tramways and Liverpool and Prescot Light Railway Companies.

THE proposal to carry merchandise on tramways is not a new idea, for practically every Act or order authorising the construction of tramways contains a schedule of rates to be charged for the conveyance of merchandise, parcels and animals, yet up to the time of the introduction of electric traction little or no advantage had been taken of the powers thus conferred, presumably because tramways could offer no convenience or facilities for dealing with these classes of traffic. In view, however, of the extension of electric tramways into rural districts, thereby joining up various systems and towns, they become not only highways for the through conveyance of merchandise, but excellent feeders to the railways of the country in general; as evidence of this it is only necessary to refer to the inter-working arrangements at present in operation between the Great Central Railway and the South Lancashire Tramways Co., whereby passengers are booked through from any station on the Great Central system to Leigh, and *vice versâ*.

The through booking of parcels without extra charge over the ordinary railway rate for conveyance on the tramways is also a feature of the arrangements existing, and this may be said to have given practically direct access, to the Great Central Railway, to many districts they previously could not possibly have hoped for.

The services thus inaugurated are appreciated by the public and are a success, giving as they do in regard to parcels frequent and regular deliveries, with quicker transit than previously existed in the district.

This inter-working with the railways for parcels, augurs well for its extension to heavy merchandise; and this brings us to the question of the "Classification of Goods." There is at present very little similarity between the "classification" used by the railway companies and that quoted in various Acts or Orders authorising the construction of tramways and light railways. In the latter case the "classification" appears to be somewhat loosely drawn out, and without due regard to the amount chargeable per ton per mile, in relation to the class and damageable nature of the articles to be conveyed. For instance, we find earthenware (Class 2, Railway Classification) included with such articles as nails, anvils, &c. (Class C, Railway Classification), and there is no distinction in other traffics, *e.g.*, "Tiles" are simply shown as such, although there are several kinds, some of high value and easily damaged, necessitating more careful handling and packing. It is, therefore, obvious, that before appreciable progress can be made in the matter of tramways and light railways becoming, as they should be, feeders to the trunk lines of railways, with through bookings and working arrangements, the "classification" must be thoroughly revised and brought into line with that in use by the railways, issued under the "Railway and Canal Traffic Act, 1888," and revised from time to time to meet the requirements of trade. It is also desirable that this should be done in the interests of the traffic that will be conveyed by tramways and light railways, for certainly articles of a high market value should pay in excess of articles of a lesser market value.

Railways, too, are not required to provide wagons for certain traffics, such as lime and salt in bulk, ammoniacal liquor, creosote, coal tar, gas tar, gas water, or gravel tarred for paving, when tendered in such a manner as would damage the wagons; but in the regulations as to rates in tramway and light railway Acts or Orders, no such provision is made, although the wagons used by the tramways would be more costly than railway wagons.

The regulations governing the forwarding of the various traffics by tramway alone need not in all instances be so stringently drawn-up as in the case of railway transit, but in the matter of through-booked and worked traffic it would be policy to conform to the railway regulations in operation for the time being, thereby saving considerable trouble and friction both with the public and the railway companies.

The carriage of explosives, and very long articles such as masts, telegraph and scaffold poles, should not be entertained, constituting as they would dangerous and inconvenient articles in the streets of towns and other places, to say nothing of the sharp corners and turn-outs to be negotiated.

The regulations governing the conveyance of merchandise by tramway or light railway should be drawn out to protect the carrier as far as possible under the various Acts relating to Insurance and Values of Live Stock, the Carriers' Act, &c., particular attention being paid to the conditions for the carriage of milk and articles of a brittle and damageable nature. These latter, including furniture loose, musical and scientific instruments, should only be conveyed at the risk of the owner.

It is important that consignment notes for various traffics, giving the regulations under which such traffics are carried, should be carefully drawn out, and obtained from all senders of traffic, duly signed at the time of forwarding, otherwise costly litigation is sure to follow, not only causing monetary loss, but giving a bad impression and upsetting the public generally.

It has been asserted that an increased "through" traffic and lessened "local" traffic on railways would tend to cheapen the existing rates, but this does not seem to be, strictly speaking, quite correct. It is well known that in the case of merchandise conveyed by railway, over considerable distances, the maximum rates allowed to be charged decrease in proportion after the first 20 miles, then more so for the next 30 miles, again slightly for the next 50 miles, and then for the remainder of the distance; but this is not so in regard to "station and service" terminal charges. Therefore, in respect to the charges other than for actual conveyance on the railway, there is no reduction, no matter what the distance carried may be; still, the terminal charges at all centres are not the same, as will be readily understood, it being obvious that the cost of labour, maintenance, &c., and rates and taxes in some places is much higher than in others.

Although terminal charges are not particularly specified in the Tramway and Light Railway Acts or Orders, a clause somewhat as follows is usually inserted :—

"In the case of goods, animals and things, the company may demand such charges as are reasonable for loading and unloading the same, and if any difference shall arise as to the reasonableness of any such charge, the matter in difference shall be settled by the Board of Trade."

This at once permits of "service" terminal charges being added on to the conveyance rates, and from the following table it will be seen that there is no necessity for a "station" terminal, the maximum rates allowed for conveyance of merchandise on tramways being so much more than those allowed to railway companies, as to render the necessity for this superfluous, although goods depôts would have to be maintained, with all the costs incidental thereto.

Maximum Station and Service Terminals.

The following terminal charges are common to all Railway Rates and Charges Orders Confirmation Acts, 1891 and 1892, except to parts of the Caledonian and North British Railway Companies systems :—

In respect to merchandise comprised in the under-mentioned classes.	Maximum terminals.				
	Station terminal at each end, per ton.	Service termina's.			
		Loading, per ton.	Unloading, per ton.	Covering, per ton.	Uncovering, per ton.
	s. d.	s. d.	s. d.	s. d.	s. d.
A	0 3	—	—	—	—
B	0 6	—	—	—	—
C	1 0	0 3	0 3	0 1	0 1
1	1 6	0 5	0 5	0 1½	0 1½
2	1 6	0 8	0 8	0 2	0 2
3	1 6	1 0	1 0	0 2	0 2
4	1 6	1 4	1 4	0 3	0 3
5	1 6	1 8	1 8	0 4	0 4

Maximum Rates for Conveyance.—L. & N. W. Railway Schedule.

In respect of merchandise comprised in the under-mentioned classes.	For the first 20 miles, or any part of such distance per ton, per mile.	For the next 30 miles, or any part of such distance per ton, per mile.	For the next 50 miles, or any part of such distance, per ton, per mile.	For the remainder of the distance per ton, per mile.
A	0·95d.	0·85d.	0·50d.	0·40d.
B	1·25d.	1·00d.	0·80d.	0·50d.
C	1·80d.	1·50d.	1·20d.	0·70d.
1	2·20d.	1·85d.	1·40d.	1·00d.
2	2·65d.	2·30d.	1·80d.	1·50d.
3	3·10d.	2·65d.	2·00d.	1·80d.
4	3·60d.	3·15d.	2·50d.	2·20d.
5	4·30d.	3·70d.	3·25d.	2·50d.

It will, therefore, be seen that whereas the railway conveyance rates decrease according to the mileage carried, no such gradation exists with regard to tramway and light railway rates, as instanced in the following schedule taken from one of the latest Light Railway Orders, viz. :—

For all coal, coke, culm, charcoal, cannel, limestone, chalk, lime, salt, sand, fireclay, cinders, dung, compost, and all sorts of manure and all undressed materials for the repair of public roads or highways, 2d. per ton per mile.

For all iron, ironstone, iron ore, pig iron, bar iron, rod iron, sheet iron, hoop iron, plates of iron, slabs, billets and rolled iron, bricks, slag and stone, stones for building purposes, pitching and paving tiles, slates and clay (except fireclay), and for wrought-iron not otherwise specially classed herein and for heavy iron castings including railway chairs, 2½d. per ton per mile.

For all sugar, grain, flour, hides, dye woods, earthenware, timber staves, deals and metals (except iron), nails, anvils, vices and chains, and for light iron castings 3d. per ton per mile.

For cotton, wools, drugs, manufactured goods and other wares, merchandise fish articles, matters or things not otherwise specially classed herein, 4d. per ton per mile.

For every carriage of whatever description, 1s. per ton per mile.

The company shall not be bound to carry single articles of great weight, but if they do carry such articles they may charge :—

For the carriage of any iron boiler, cylinder, or single piece of machinery or single piece of timber or stone or other single article, the weight of which, including the carriage, shall exceed 4 tons, but shall not exceed 8 tons, such sum as the company may think fit not exceeding 2s. per ton per mile.

For the carriage of any single piece of timber, stone, machinery, or other single article, the weight of which, with the carriage, shall exceed 8 tons, such sum as the company may think fit.

The railway companies do not, or very rarely indeed, charge their maximum rates; therefore, and especially where railway companies cover the same ground as tramways or light railways, the "Tramway and Light Railway Rates Schedule" is of little use. The rates charged for tramways and light railway traffic must not in any case be higher than those charged by the railways, but should be considerably lower, the total working cost of tramways being so much less than that of railways. In the case of coal, it is very questionable whether it would not be best to leave the carriage of this, entirely to the railways; they already have sidings under the colliery coal shoots, and the cost of running electric tramway sidings thereto would be very heavy. Moreover, the colliery proprietors do not readily entertain the idea of two sets of metals side by side under one screen, which would become necessary, seeing that the wheels of one class of wagon are not made to run on the same rails as the other, and *vice versâ*, to say nothing of the prohibitory clauses in the Orders and Acts. While admitting there are numerous difficulties in the way, it would be of great benefit if means could be found and arranged for the working of tramway wagons over short lengths of railway sidings into works, &c.

The colliery proprietors also point out the difficulty of shunting the two kinds of wagons, the specially designed points which would be necessary, and many other difficulties, also that the rates for the conveyance of coal by railway are so low as not to invite them to erect special screens and facilities for dealing with tramway traffic alone. The following illustrations show this :—

From.	To.	Distance. Miles	Rail charge per ton whole distance.	Tramway charge, say, 2d. per ton per mile whole distance.	Description of traffic.
Haydock	Liverpool	15	1s. 4d.	2s. 6d.	Coal.
St. Helens	do.	12	11d.	2s.	Coal.
Liverpool	Atherton	24¾	7s. 3d. including cartage at Atherton.	At 4d. per ton per mile, 8s. 4d. (station to station only).	Raw cotton.

The distances between the places mentioned are about equal by both rail and tram.

The maximum rates allowed by the tramway and light railway schedules might, however, be charged in districts not opened up by railways, and where cartage charges are extremely heavy, as, for instance, from Corwen to

Cerrig-y-Druidion, and Bettws-y-coed to Penmachno, each distant about 10 miles and the cartage being at the rate of about 10s. per ton; a light railway scheme for joining up the places named is in course of preparation at the present time.

While admitting that it is possible to do away with much of the handling of merchandise now performed by the railway companies, on account of trans-shipment at junctions, it must not be overlooked that the fault lies to a great extent in bad loading and short junction lines. All railway companies run "roadside" wagons between their principal stations on to branch lines, so that merchandise shall not be handled more than once or twice on a journey, and then only when it is necessary to put out at a junction, otherwise the "roadside" van would pass through, working on to another branch from that to which the goods were going. The trans-shipment of goods on railways is not so frequent as it would seem to be, and everything possible is being done to curtail it, but at the same time it does not increase the charges made for the carriage of goods.

(*To be continued.*)

LEGAL.

City of London Electric Lighting Co. *v.* the Mayor and Corporation of the City of London.

In the House of Lords on Friday (the 7th), the Lord Chancellor and Lords Davey, Shand and Robertson gave judgment in the case of the City of London Electric Lighting Co., Ltd., *v.* the Mayor and Corporation of the City of London, the arguments in which were heard some time back. Both parties appealed from a decision of the Court of Appeal given in February, 1901, by the late Lord Justice Rigby and Lords Justices Vaughan Williams and Stirling, whereby an order by Mr. Justice Farwell, made at the time of the action in favour of the company was varied, and each party ordered to pay its own costs.

In the action the company claimed a declaration that (1) an agreement, dated May 19th, 1890, between the British Electrical Engineering Co., Ltd., and the Commissioners of Sewers of the City of London; (2) an agreement, dated May 28th, 1890, between the Laing, Wharton and Down Construction Syndicate, Ltd., and the said Commissioners; and (3) an agreement dated February 5th, 1891, between the Brush Electric Co. and the said Commissioners were valid and subsisting.

The three agreements were transferred to the company by two indentures dated August 21st, 1891. The Corporation, which was the successor in title and office of the Commissioners of Sewers, alleged against the company's claim that certain members of the Corporation were shareholders in that company. At the date of the contract with the Laing Syndicate, no commissioner, alderman or common councillor was a shareholder in the syndicate, but at the date of the transfer on August 21st, 1891, by the syndicate to the company, several gentlemen holding such municipal offices were shareholders. The Corporation therefore said, that as there were persons "interested" in the contracts, the contracts, by Sec. 42 of the City of London Sewers Act, 1848, were rendered null and void. These contracts were for lighting different areas of the City by electricity, and the City had been lighted under these contracts since 1891, but in 1898 the Corporation, acting on legal advice, repudiated the contracts.

Mr. Justice Farwell, in a considered judgment, expressed the opinion that the Act of 1848 contemplated that the Commissioners should enter into contracts of two sorts—(1) for the construction of works or supply of materials to the City, which would become their own property, and which he called "construction contracts"; and (2) for the supply of water for cleansing, or of gas or other illuminant for lighting the City by companies or persons owning waterworks or gasworks or the like; that the contracts in question in this case fell under the second head, and that Secs. 33 to 42 of the Act of 1848 formed a group of sections dealing with construction contracts, and that notwithstanding the generality of the language of Sec. 42, that section, which said that no City official should be directly or indirectly interested, upon pain that every such contract should be null and void, applied only to construction contracts. He also gave other reasons for holding that the disability in the section did not apply. He therefore made a declaration in favour of the company, and the Corporation appealed to the Court of Appeal, which varied the decision of the learned judge so far as it related to the agreements dated May 19th, 1890, and February 5th, 1891, and declared that those two agreements, for the reason relied on by the Corporation were null and void, and that the Corporation was not bound thereby. The company then appealed to their Lordships' House, and the Corporation also appealed against that part of the order that was not in its favour.

Mr. Cripps, K.C., and Mr. Roskell (instructed by Messrs. Ashurst, Morris & Crisp) appeared for the company; Mr. Lawson Walton, K.C., Mr. Danckwerts, K.C., and Mr. A. G. Walter (instructed by the City solicitor) for the Corporation.

On August 7th, the Lord Chancellor, in moving that the appeal should be dismissed, said: In this case a declaration is sought to establish the validity of three contracts entered into between the City of London Electric Lighting Co., Ltd., and the Mayor, Commonalty, and citizens of the City of London. The question sought to be raised by the parties is whether or not the contracts, or any of them, entered into between the parties are valid and binding on the defendants. The defendants have repudiated them—not, as I understand, that they have any objection to the substance of the contract; but, being advised by counsel that the contracts were invalid, they felt bound to test that question in a court of law. Mr. Justice Farwell, before whom the question came, was of opinion that they were valid. The Court of Appeal had declared them to be invalid, allowing the third to stand. The whole question turns upon S. 42 of the London Sewers Act, 1848, which provides "that no person being a commissioner or a member of the Court of Aldermen, or of the Common Council of the City shall be, directly or indirectly, interested or connected in any contract which shall be made or entered into by, or on behalf of, the Commissioners for the execution of any works by this Act directed or authorised to be done or executed, or for furnishing materials or labour, or for any other matter or thing whatsoever, upon pain that every such contract shall be null and void; and that any person who, being a Commissioner, or a member of the said Court of Aldermen, or of the Common Council, shall be so interested or concerned therein, shall, for every offence, forfeit and pay the sum of £100 to any person who shall sue for the same, to be recovered in any of the superior Courts by action of debt or on the case." At the date of the contract there were shareholders among the Commissioners, Aldermen and Common Councilmen, and I so far agree with Mr Justice Farwell, that I think the first thing to see, is whether the Act of Parliament is clear, or is fairly susceptible of two constructions. I regret to have to add that I think it is clear and is not fairly susceptible of two constructions. In a very ingenious and elaborate judgment, the learned judge decided in favour of the validity of the contracts in question, upon the ground that they are not what he calls "construction" contracts; but I am unable to concur with the view that the section is only applicable to these construction contracts. If such a distinction can at all be made, the disqualification under the statute which I have quoted does not apply. The Mayor and Corporation of the City are now (since 1897) in the place of those who at the date of the contracts were the Commissioners of Sewers of the City. By the Act of 1897 all their duties and liabilities are now vested in the City itself. That the aldermen, commissioners and common councilmen have a disqualifying interest in the contracting companies cannot be denied unless the distinction insisted on by the learned judge can be made out. In respect of two of the three contracts, it is admitted that a common councilman, a Commissioner of Sewers and a Lord Mayor for the time being—in that character both an alderman and *ex officio* Commissioner were shareholders; and in respect of those two contracts, heartily as I regret the conclusion to which I am forced to come, I cannot doubt that these contracts, by reason thereof, are invalid. I have striven to escape the stringency of the language, since I think no one will doubt that the contracts were fairly and properly made, with due regard to the public interest, but I cannot escape from the language of the Statute. With respect to the third contract, I agree with Lord Justice Stirling that a different question arises where, at the time of the making of the contract, no Commissioner, Alderman, or Common Councilman was a shareholder; and I agree with him that, under the circumstances stated in detail by the learned judge, the contract has not become invalid because, at a subsequent date, several Commissioners, Aldermen and Common Councilmen became shareholders. The result is that I think the judgment of the Court of Appeal is right, and that this appeal ought to be dismissed with costs. I move your Lordships accordingly.

The other noble and learned Lords who heard the arguments gave judgment to the same effect.

The appeal was accordingly dismissed with costs.

Metropolitan Electric Supply Co. *v* Borough Council of Marylebone.

In the Chancery Division of the High Court of Justice on 7th inst. Mr. Sergeant, on behalf of the plaintiffs in this case, stated that, since his Lordship pronounced judgment, negotiations had taken place between the parties, and they had now agreed to an order which would avoid the necessity of a long and expensive inquiry as to account and abatements. His Lordship assented.

Chamberlain & Hookham, Ltd. *v.* Bradford Corporation.

In the House of Lords, before the Lord Chancellor and Lords Davey, Shand and Robertson, an appeal by the plaintiff company from a decision of the Court of Appeal, affirming a judgment of Mr. Justice Farwell, was heard. The appellants were the owners of an invention for improvements in "Electricity meters," and they proceeded against the Corporation of Bradford, who are the lighting authority for that town, for an infringement of their patent. The trial lasted eight days before Mr. Justice Farwell, and he held that there had been no infringement, but did not decide the question whether the patent was or was not valid. The Court of Appeal, after a ten days' hearing, affirmed the judgment below, but also gave no decision on the validity of the patent. The company then appealed to their Lordships' House.

Mr. Astbury, K.C., Mr. Arthur J. Walter, and Mr. Robert Frost (instructed by Field, Roscoe & Co., agents for Pinsett & Co., Birmingham) appeared for the appellants; Mr. Cripps, K.C., Mr. Bousfield, K.C., and Mr. J. C. Graham (instructed by Ashurst, Morris, Crisp & Co.) for the respondent Corporation.

At the close of the arguments, judgment was reserved.

On August 7th, the Lord Chancellor said: I have seen the judgment which Lord Davey is about to deliver in this case. I agree that the appeal should be dismissed, and for the reasons that he will state.

Lord Davey then read his judgment, of which we give extracts below:—The appellants sue the respondents for infringing certain letters patent vested in them, by using an electricity meter which the appellants say is substantially the same machine as that described and claimed by Mr. Hookham, the patentee, in his specification. In describing the nature of his invention as applied to an electricity meter the patentee says:—"My electricity meter consists essentially of an electro-motor with constant, or nearly constant, field, the armature carrying the current to be metered, and an electric brake consisting of a mass of metal in the form of a disc cylinder or other figure of rotation, rotating in a magnetic field in such a manner as to have 'eddy,' or so-called 'Foucault,' currents generated in it. When all other work done by the motor (*i.e.*, in overcoming friction) is negligible with that done against eddy currents, the speed of rotation of its armature is directly proportional to the armature current." The patentee then describes the special means which he adopts in order to reduce friction.

The first claim is for "an electricity meter for measuring currents, consisting of an electro-motor with constant field arranged substantially as hereinbefore described, and illustrated in the accompanying drawings, the said electro-motor being combined with an electric brake also moving in a constant, or nearly constant, field, preferably the same field as that in which the armature rotates substantially as herein described and illustrated in the accompanying drawings." The only form of Hookham's meter which is described in detail in the specification and illustrated in the drawings is one of a special character, in which the armature and the brake form two sides of one disc, and the field magnet is an electro-magnet, magnetised by a shunt current from the main. The pole-pieces of the magnet are of a broad flat shape enclosing the disc on the two sides of it, and supplying the field for both the armature of the motor, and the brake. The current from the main, which is to be measured, is led through the armature, which is divided for the purpose into 16 sectors. Directions are given for the "saturation" of the electro-magnet in order to produce a constant field, and mercury commutators are used for minimising the friction. It would, of course, be wrong to confine the patentee to the exact form of his combination which he has so described and illustrated. I also think that he is entitled to the merit of having first given to the world a practicable electricity meter made on the principle of combining the use of an electric brake operating by means of Foucault currents with an electro-motor, and to have regard paid to that circumstance in construing his patent. But, on the other hand, it would be equally wrong, and, indeed, would be fatal to the validity of the patent, to allow the patentee such latitude in the construction of his patent and variation in its details as would entitle him to claim every form of electricity meter in which an electro-motor is combined with an electric brake of the kind described, or that combination coupled with a device of any kind for reducing friction—unless he can claim to have himself discovered the principle of such a machine. It may be that Hookham thought he was the first to hit on the idea or principle of applying the phenomenon of the Foucault currents to the construction of the brake of an electricity meter. But if so, it was only because he was not aware of the information on the subject which had previously been published in this country.

The patentee has said in his specification that almost every detail in his combination may be varied. The elements of the combination which admit of no variation appear to me to be the following:—(1) That the meter is a current meter, *i.e.*, for measuring only the quantity or ampere-hours of the current without regard to any variation in the potential or voltage (2) that the magnetic field of the motor must be constant; (3) the use of the patentee's mercury contacts or commutators "where practicable."

I turn now to the meter used by the respondents, which is said to be an infringement of the appellants' meter. The conclusion which I draw from the evidence of the expert witnesses (including the patentee himself) is that beyond the fact that in both machines an electro-motor is used in combination with an electric brake, the two machines have little in common. In the first place the respondents' machine is not one of the same type as the appellants'. It is not a current meter, but a meter which is designed and intended to measure energy, that is, the ampere-hours multiplied by the voltage, and is therefore made sensitive to every variation in the potential in the generating station. The magnetic field with which the electro-motor works is therefore not constant, as in the appellants' machine.

As they do not require a constant field, the respondents use neither a saturated electro-magnet nor a permanent magnet in connection with their motor. In fact, so far as the motor is concerned, it is admitted by Mr. Hookham (QQ. 301—6) and Mr. Swinburne (Q. 1,149) to be the same as that shown in the drawing of Siemens's meter. The respondents say they are as much entitled as the appellants to avail themselves of Marcel's suggestion to use an electric brake with any suitable magnet of an ordinary form in connection with Siemens's meter. The respondents use solid brushes tipped with silver, and having silver points of contact, and do not use the mercury or liquid commutators of the appellants. The use by the respondents of a small coil on their shunt wire for the purpose of starting the motor was relied on by counsel for the appellants as an infringement of Hookham's suggestion that he may compound wind his magnet. I regard that suggestion as nothing more in substance than a working direction to increase the driving power to the required extent.

I now come to the question raised by the appellants as to the magnet used by the respondents in connection with the disc of their brake. This topic has, in my opinion, been the subject of an amount of evidence and argument quite disproportionate to its real importance. I am of opinion that the third claim of the patent cannot be supported as a claim to a separate head of invention applicable to magnets used in any electricity meter. It can only (as I think) be supported as pointing out what the patentee considered one of the merits and advantages of a subordinate element in one of the forms of the general combination claimed in the first claim, and as applicable only to the meter invented by the patentee. On the construction of the third claim, I think also that it is confined to the use of the magnet in connection with the armature of the motor. I find a reason for the patentee confining his claim to the use of the magnet in connection with the disc armature in the evidence which he gave at the trial. He assented to the proposition put to him by counsel, that when you are dealing with the motor you want to spread your field as much as possible, and when you are dealing with the brake you want to concentrate it as much as possible, and consequently when you use (as the patentee does) the same magnet for the motor and the brake you have to strike a balance. The requirements therefore are not the same in each case.

Now what is it that the respondents have done? They use for the purpose of their brake a magnet which is formed of a single steel bar bent into the shape of an elongated loop so as to enable the disc to rotate freely between the poles of it. This magnet has previously been subjected to a very severe treatment for the purpose of "ageing" it, and thus securing its constancy by a well-known method. *Consensu omnium*, this magnet is of an ordinary form. On the evidence in the case I do not think that the respondents' brake magnet is a colourable imitation of anything described and claimed in the patent.

My Lords, I am of opinion that the judgment of the Court of Appeal, confirming that of Mr. Justice Farwell, was right. I see no grounds for saying that the case was not fully considered in the Courts below as suggested by counsel, and, indeed, I do not think that when the facts are understood there is any extraordinary difficulty in it. For these reasons I think that the appeal should be dismissed with costs.

Lord Shand and Lord Robertson concurred.

The appeal was accordingly dismissed with costs.

Hiram S. Maxim Electrical Corporation, Ltd.

In the Chancery Division of the High Court of Justice last week an action brought by Emile Pulsford, on behalf of the Société Centrale d'Electricité et de Lampes à Incandescence, against Mr. M. Devenish, liquidator of the above-named corporation, was concluded before Mr. Justice Farwell. The plaintiff claimed damages on the ground that the defendant had wrongfully distributed the assets of the Corporation without providing for the rights of the plaintiff, under an agreement of March 2nd, 1900, and for a sum due to the plaintiffs for lamps supplied.

After hearing the evidence, his Lordship said that the liquidator knew of the plaintiffs' claims, but took no steps to ascertain the debts owed by the Corporation, beyond advertising in the daily papers. He had absolutely neglected his statutory duty, and had himself received a large number of shares in the company which purchased the Corporation's business and assets. His Lordship held the liquidator liable in respect of the amounts due under the plaintiffs' agreement, and the purchase money for the lamps. A stay of execution was granted, subject to the money being paid into Court.

CORRESPONDENCE.

A Motorman Instructor's Views.

For about five years I have been connected with and driving the popular electric car. I must admit that it's not all honey—the constant strain on your eyes, the suddenness of danger, your ears listening for bells, your feet always in one position, both your hands fixed, &c., but with it all there are to be got by proper training men of a very satisfactory type, viz., railway men, such as shunters, goods guards, drivers, and firemen, who turn out the best on any sort of route. I drove on gradients of 1 in 9 with heavy and light loads, good and greasy rails, slow services, quick services, single roads and double, and have kept a clear sheet from all companies I have worked for.

My first dealings with novices were while driving in service of town trams. My first question was "What occupation have you been following?" "Oh! I was a driver on the Gt. C. Got paid off for running by signal," or such like. Well, I knew his late berth was suitable for this one. "Just watch me for a few hours, mate; see how I use this controller, and you will soon be in our uniform and get your 6d. an hour." I soon got confidence in the man, as I knew he was used to travelling under steam, but now he got electricity. "I suppose you get bad rails, same as us with a train?" I said yes, and got him to use his sand pedal, &c., so that when you want it you know you get it. This man was soon polished off and ready for a service car. The

next chap I got was one who said he was a baker, but had been a gardener. He took as long again as the driver of Gt. C. to understand the brake alone, and if a boy, or girl, or trap got in the road, I had to do the needful. Well, it was no good putting my name to that man's paper, as I wanted to gain promotion; so I told him, and, of course, he challenged me to pugilistic fame. After that I sent the paper inside an envelope, telling them nothing. It's not a very thankful job to tutor men of this type on your car during service hours; you are held responsible for the man's progress and conduct, also for the charge of car, safety of passengers, and running to time. My mates used to shout "you've got a soft job on." Get the right grit in the pupil, and you can take it much easier, as you get confidence in him and can shift from him; but get a dull pupil, you have to watch and be ready to push him out of the way and do the needful, as they are sure to leave juice on, or some other neglect. Some don't pay any attention to signals from guard; some won't stop in loop on single road if car is approaching. You have to tell, tell, tell, over and over again. This class of man wants three months' practice, and then to go to a company where there's only one tram, so I think it best to polish that chap off as soon as possible. The training is the making point, I must admit, but you don't want a school for about 50 drivers. Glasgow is all right, no doubt, but if I were on a tour of inspection, I certainly should not go by Sheffield. The men you see there will want some beating. I think all electrical engineers of traction experience will admit that the sober railway man is all right. In fact, I have never had easier men and quicker to grasp the control of a car.

I agree with Glasgow asking the men about their instruction every now and then. I believe in making them tell all chief working parts and answer about a dozen questions, such as what would you do if your power handle got fast on the seventh or any notch of controller and you saw danger close by? He answers all right, knock switch off, &c., but let him go and say no more to him for a month or two, no doubt he would say put the electric brake on! Training is not so soft a job as it looks.

Driver Quick-Stop.

Development of the Current Interrupter.

It may interest Mr. Wright to have additional confirmation as regards the use of the Wehnelt break. I have seen this break in use in Paris on an alternating circuit, and, although I did not watch the break for any length of time, there did not appear to be any undue heating; and I am given to understand that no difficulties are experienced.

W. G. Steinthal.

Bradford, *August 7th*, 1902.

If Mr. Isenthal will read my letter again, he will find that I did not state that it was absolutely impossible to use the Wehnelt interrupter on the alternating current mains, but simply commercially impossible.

"*If so used*," the platinum tip must be fed forward in the manner of an arc lamp carbon, costing several shillings an hour.

The use of an aluminium plate is in this case not permissible, since it acts virtually as a rectifier, thus passing a rectified *continuous*, not an alternating current.

The very suggestion of an aluminium plate shows that the break is not satisfactory on alternating circuits.

Therefore I beg to repeat my statement, that it is not commercially possible to use the Wehnelt interrupter directly on alternating current circuits.

Mortimer A. Codd.

London, *August 10th*, 1903.

Hot-wire Arc Lamps.

I have read with interest the article by Mr. H. Tomlinson-Lee on "Hot-wire Arc Lamps," and the criticism by "N. D. W." I have handled and sold large numbers of arc lamps of various makes, and have frequently had to adjust them and do small repairs upon them, and my experience has been exactly that of Mr. Tomlinson-Lee—that is, that the dash-pot is the cause of most of the trouble; as a matter of fact, I make it a rule to attack that point first, and in nine cases out of ten I find the fault there. If Mr. Foster can do all that it appears he can, I should say that he will find a large market for his lamps.

C. M.

Having read "N. D. W.'s" letter in your "Correspondence" columns of this week, we crave your kind indulgence for a space, that we, the makers of the lamp in question, may clear up some vague doubts that appear to exist in "N. D. W.'s" mind.

We want everyone to share in the latest knowledge on arc lamps, "N. D. W." as well. Besides this, the object of his letter is an attempt to belittle the improvements we have spent four or five years in achieving—improvements we have already established as practical facts of commercial value. No doubt Mr. Tomlinson-Lee will have something to say concerning the personal nature of the attack, but we should be glad of the opportunity to deal with the points immediately affecting us.

To begin with, on dash-pots, the present writer has had as good an opportunity—probably a better—of studying enclosed arc lamp troubles as "N. D. W." has. He was responsible at one time for the repair department of a firm as well known as any, and he paid particular attention to the "cause of failure." He would allow no unknown causes such as "N. D. W." hints at.

We are naturally debarred from giving actual figures from another firm's books, but they were of an inverse relation to "N. D. W.'s" figures, the bulk of the failures being set down to the dash-pot, *some to mechanism* and bad trimming, and least of all to faulty insulation.

But let us consider his figures. He says: "The percentage of failures due to dash-pot sticking, taken from the books of one of the best-known makers, is given at ·1 per cent., while dirty rods, improper trimming, and breakdown of insulation account for ·9 per cent. of the *known* cases." Now, then, Mr. "N. D. W.," how do you account for the balance of 99 per cent. in the known cases, and what have you to say for the unknown causes of breakdown, and how many such were there? Does the 99 per cent. mean troubles in the mechanism other than the dash-pot? Please explain.

Mr. Tomlinson-Lee's remark "about 2 ohms"—obviously given *en passant*—was not intended to be exact, but it is very much nearer the truth than "N. D. W.'s" 99 per cent. error, not to speak of the vague unknown!

Putting figures aside, we *have no* dash-pot, we *have no* "rods," and we do not require the, comparatively speaking, enormous amount of insulation (combustible and otherwise) required by the solenoid lamp, so we *have* eliminated all the troubles you admit, with the exception of the lamp attendant, and the law of the land saves him.

If "N. D. W." knows of hundreds of lamps working satisfactorily for "a number of years without any dash-pot troubles of any description," the makers of which lamps have presumably eliminated dust from their hundreds of dash-pots, then we say it is the Millennium "N. D. W." is concerned with, and not "1903 or 1890." A dash-pot *cannot be made* which will not be affected by dust to the detriment of the coil. The only remedy for solenoid lamps is to frequently remove the dust from the dash-pots, which means skilled attention and money. We hope this is not the last word on dash-pots, and that the contractors, who suffer quite as much as the makers, will propound their views.

A "reaction in favour of arc lighting" is certainly needed in Manchester, where, if we are rightly informed, they are discarding arc lamps in favour of incandescent gas. Perhaps some other readers, who are not prevented by one interest or another, would state some more cases. The engineers directly responsible for street lighting might give their views.

As regards three enclosed arc lamps in series on 240 volts, what "N. D. W." says is that three solenoid lamps would behave as well as three hot-wire lamps, "provided, of course, current consumption and 'voltage' across the arcs were similar." Exactly, "N. D. W.," but you cannot get the "voltage" across the arc with a solenoid lamp; you want too much steadying and really wasteful resistance. Ever since the advent of high voltage—230 to 250—distribution, users have been asking in vain for an enclosed lamp that would

burn three in series. We know it was attempted in Glasgow (250 volts), but with little or no success.

As regards the 50 per cent. gain by this system, this is quite simple when you know anything about enclosed lamps. When faced with a high voltage, the solenoid lamp can only obtain a good *electrical* efficiency by increasing the arc voltage. This produces an arc of disagreeable blue light of practically no higher *illuminating* value than the arc of lower voltage but white light. Thus the solenoid lamp has to waste the additional 20 or 30 volts on the steadying resistance. We use very little resistance, and get far more volts at the carbons. Consuming the same current, we get three good white lights instead of two blue ones, and we get better distribution, hence 50 per cent. more light for the consumer.

We think there is another point "N. D. W." should "crave" of Mr. Tomlinson-Lee, but not what "N. D. W." means. Before asking the writer of the original article how he "obtains" certain figures, he should have made sure that Mr. Tomlinson-Lee had obtained them! As stated in the article, Mr. Foster obtained the 72-volt arc, and it is also clearly stated by Mr. Tomlinson-Lee that the circuit voltage was 240, *not* 220. We shall be happy to give further figures concerning this test, if anyone needs them; meanwhile, we are wondering whether "N. D. W.'s" mistake was accidental or otherwise.

"N. D. W.'s" next enquiry suggests his own knowledge that lamp mechanisms can, and do, get dirty, and thus by natural inference he contradicts himself. He "would like to know what would happen to the three lamps running in series on a 220-volt circuit if the mechanism of one became dirtier than the others." Our answer is, absolutely nothing. It would not "refuse to strike," and it is wrong and improper of "N. D. W." to try and thrust on Mr. Foster's splendid invention any other false suggestions. We do not mind how much dirt within reason gets into the lamp as it makes no difference whatever. We know you cannot prevent dirt getting into the mechanism, and that is just what Mr. Tomlinson-Lee's argument consists of. Further conclusive evidence on the three-in-series query will be found at the end of the article in the paragraph by the Editors.

As regards the commercial value of the "change over" from A.C. to D.C., we can only say that we have two orders of this kind for over 60 lamps. Enquiries have been made to our certain knowledge for "change over" lamps during the last two years.

We shall be happy to give "N. D. W." any further information he may require, but meanwhile would venture to suggest a short study of the "three R's" as well as Ohm's law.

Foster & Co.

Wimbledon, *August 10th*, 1903.

The remarks on my article respecting the above by "N. D. W." are possibly the result of his misconception and incredulity. To strengthen his arguments and to obtain some end best known to himself, he has chosen misquotations in lieu of the statements contained in my original article. I would therefore suggest that, before he again places himself in such a hypercritical position, he pays a little more attention to that which he reads, and a little less attention to Ohm's law. Ohm's law is an established fact, and when the conditions attached thereto are thoroughly understood, and are in the hands of those capable of dealing with them, the law will always prove itself correct.

However, in my endeavour to treat the matter concisely, and to convey a general idea of the principles and capabilities of the "Foster" lamp, it was necessary to omit the fuller particulars and details connected with the tests, the results of which I only mentioned in my article. I therefore cannot hold myself responsible for the opinions arrived at by "N. D. W.," who is so ready to condemn this new departure in his profession.

May I invite other readers of your paper, also the patentee of the lamp, to express their opinions of the article, as I have no doubt they will show a little more courtesy to the writer than "N. D. W.," who prefers to hide his light (arc) behind a *nom de plume*, which latter procedure I have always considered to be one of the privileges of an enlightened Press—not a privilege to be abused, however.

In conclusion, I would ask "N. D. W." to endeavour to read correctly, and then he will see that the voltage stated in the article is 240, and not 220 as he states in his letter.

H. Tomlinson-Lee,
Chief Electrical Engineer.

Wimbledon Electricity Works, *Aug. 10th*, 1903.

Our Fiscal Policy.

Mr. Byng possesses the bump of egotism to an extent not usually developed in the *genus homo*; for "talking through his hat," he has no equal, and having built up his business, and feathered his nest by importing goods from the Continent under Free Trade conditions, and for years cutting against the prices of English manufacturers, cries aloud—as a voice crying in the wilderness, let us hope—for Protection, now that he manufactures here.

In your leading article of July 31st you relate the story of the manufacturer of glass prisms for chandeliers who lost his trade from Continental competition, but who turned his attention to the chandeliers themselves, and made his fortune by manufacturing them. You then suggest that if Mr. Byng cannot make his carbon works pay in the face of Continental prices, he should devote his attention to increasing his output of arc lamps.

That seems reasonable enough. The law of progress is one of change, and in all times there have been natural changes and movements in the world's industries.

Take, for example, the watch trade, which Mr. Byng passes in review in his book on "Protection."

Coventry was once the leading centre of the silk trade; it turned to watch making, and when the American machine-made timekeeper spoiled the trade, the town readily adapted itself to the altered circumstances, took up the bicycle industry, and is now more prosperous than at any previous period.

Under a natural system of trade, industries adapt themselves to wants, and the story of Coventry is a very fair instance.

One of the most frequent objections brought against the Free Trade policy of Great Britain is that other countries have not adopted it. For a clear, lucid and convincing exposition of why the leading commercial nations of Europe, the United States, and our own Colonies have not followed our example, I would refer Mr. Byng and all other readers of the ELECTRICAL REVIEW to a volume published only last week, entitled "The Free Trade Movement and its Results," by G. Armitage-Smith, M.A. Second edition.

If this does not effectually dispose of the seemingly ingenuous, but very transparent, views advanced by the author of "Protection—the Views of a Manufacturer," there is but one thing left.

Mr. Byng will give up his manufacturing business in England, resort to his previous trade of importing Continental goods, undersell the British manufacturer, and again become a convert to the blessings of Free Trade with the shekels attendant thereon.

Much has been made of German progress under Protection; correctly speaking, it should be German progress since the adoption of internal Free Trade.

In America, too, the States comprising the Union trade freely with one another. This freedom extends over 51 States and territories, covering an area of 3,500,000 square miles, and including every variety of climate and every kind of product.

If severed from the rest of the world, its people might still live in comparative affluence, and it is not, therefore, very wonderful that they should be able to uphold a system of Protection under such circumstances.

Great Britain is unable to provide herself with sufficient food; raw materials and food-stuffs together account for nearly 75 per cent. of her imports, while manufactured goods represent about 75 per cent. of her total exports. England then occupies a position which differs *in toto* from that of any other country.

It can be shown that by a natural law, industries tend to move to, and flourish in, localities best adapted to their requirements. By artificial obstructions, such as protective tariffs, we may attempt to direct and retain industries, but

only at considerable loss, and waste of natural productiveness.

Although for reasons not far to seek, Free Trade has not been adopted by other countries, or by most of the Colonies, yet there is strong indirect evidence for the soundness of the principle of commercial freedom in the *internal* fiscal arrangements of large States and federations of States.

The United States place no restrictions on the trade between the several States, and every new territory admitted to the Union is placed on the same footing; the same principle is adopted in the Dominion of Canada, and in Russia and Germany.

Had Protection any economic advantage, its virtue would not cease with the political inclusion of a territory in a country; the local industries should require the same defence as formerly. If a country is of vast extent, and its climate and products very varied, and if it possesses minerals as well as abundance of land, it is most favourably situated for industrial independence, for it has within itself resources of all kinds.

The smaller the country and the more specialised its products, the greater is the advantage it gains from contact with others, and such in an eminent degree is the case of Great Britain.

And now will Mr. Byng kindly tell us whether the taxation of raw materials would increase the selling price of his machinery, and what percentage he would impose?

Also whether a preference of a given percentage in Colonial markets, and Protection at home, would increase his business to the extent of warranting a higher wage to his workmen, and if so, whether he would pay it considering that the wage question is mainly one of supply and demand?

Furthermore, would the taxation of imported foreign machinery raise to any considerable extent the prices to the "consumer;" that *bête noire* of Mr. Byng.

Finally, does he, or does he not, use foreign labour saving or other machinery in his works, which English firms are unable to supply?

A Man of no Experience.

Protection or Fair Trade?

There is one point insisted upon in Mr. Byng's letter of last week which should, I think, be borne in mind by everyone who engages in the present fiscal discussion. Mr. Byng says that the nation must be regarded as a family, to which both the consumer and the home producer belong, and that it is the interest of that family—the whole nation—which must be considered. In dealing with this complex question, which absolutely bristles with fallacies, the aforesaid method of dealing with the points in dispute is the one safe guide, and clears up a multitude of difficulties.

The family has, of course, a private income—its dividends on investments abroad; some of its members bring in some earnings also as carriers of other families' goods; in the main, however, its wealth depends on what it can produce in the home, much of which goes in exchange for the productions of surrounding families. This annual wealth, produced in the home and supplemented to a comparatively small extent by the private income, is distributed among the producers in the convenient form of wages. The system of distribution may be defective, but there is no serious risk that the family as a whole will be rich and the bulk of its members in poverty.

Now, it is clear that the one desideratum is to make the home production a maximum. To secure that end it is evident that the production of articles which can be more efficiently produced elsewhere should not be undertaken *so long as all in the home are fully employed*, for such a policy would divert labour in the home from a more efficient to a less efficient direction. The important thing to note, however, is that if some of the members of the family are unemployed, or if those who are at work are capable of producing without undue effort more than they are now producing, every extra article that can be made by an agreement among the members of the family not to buy it from outside, is a clear gain, even though it may be produced with a greater expenditure of labour than would have been required elsewhere. In fact, the family should decide to what articles it can best devote its own labour, and resolutely decline to buy any such articles from surrounding families. This self-denying ordinance must obviously end at such a point as enables its own energies to be fully occupied.

The fallacy of the Free Trade argument, that it must be a loss to the country to produce at home what can be purchased cheaper abroad, is thus rendered quite clear when the family interest is considered. It can also be shown in the following way:—Imagine a country possessed of no great natural advantages, and unable to produce even its own most-efficiently produced goods without expending 10 per cent. more energy than is necessary in some more fortunate country abroad. If such a country falls into the hands of the Free Trade statesman, its production is bound to reach a very low level, for it is cheaper to buy every article abroad than to produce it at home. There will be a huge balance of imports over exports, and grave danger that by the time home production *must* be commenced in earnest (owing to the impossibility of paying for the imported goods), the country will have exhausted its reserves of capital, or failed to supply the continual renewal which all capital demands, and will be without the means of setting its industries going unless by borrowing abroad at what must be, under the circumstances, a high rate of interest. Free Trade principles end here in ruin.

Turn now to the Protectionist statesman. He starts with the proposition that *home production must be made a maximum*. He resolutely imposes heavy duties (*raising prices* be it observed) on such articles, whether food stuffs or manufactured goods, as can best be produced at home, and he includes in his scheme of taxation an area large enough to give all the available labour full occupation. At this point he stops. What is the result? A nation only 10 per cent. poorer in its average income than the wealthiest nation in competition with it. Surely no very calamitous result!

The bearings of these observations lie in the application thereof. If our statesmen will only bear in mind the one point of cardinal importance—the raising of home production to a maximum—there is little to fear for our commercial future.

A.I.E.E.

The Electric Conductivity of Copper.

The last table of the article which appeared under the above title in the ELECTRICAL REVIEW of July 10th was derived upon the assumption that the increase of resistance due to a rise in temperature of copper from 60° to 75° F. could be calculated by the use of the coefficient 1·035925. This coefficient was formed by adding 1 to (75 − 60) × 0·002395, which obviously is incorrect. The same kind of error accounts for discrepancies in calculating the resistances, in standard ohms at 60° F., of the foot grain, from the figures given by Fleeming Jenkin in the year 1873. A further point arises as to whether, in the article, it would not have been better to have applied Matthiessen's rather than Clark, Forde and Taylor's coefficients to the copper referred to by Fleeming Jenkin. In order to remove any question that might arise on this point, I have revised these figures according to both methods. Thus the co-efficient obtained by Clark, Forde and Taylor, reduces 0·2262 B.A. ohms at 24·0° C. (75·2° F.) to 0·21579 standard ohms at 60° F., and it reduces 0·2186 B.A. ohms at 15° C. (59° F.) to 0·21614 standard ohms at 60° F. In contrast with these figures, Matthiessen's formula reduces 0·2262 B.A. ohms at 24° C. to 0·216124 standard ohms at 60° F., and it reduces 0·2186 B.A. ohms at 15° C. to 0·216113 standard ohms at 60° F. It follows that the figure 0·216226, which Mr. Kempe deduces from the report of the Committee of Experts and Manufacturers, is somewhat above the old standard. The figure 0·2162 which I used in the article as a tentative standard, is nearer to the old standard, and is a more simple figure.

I should be glad if you would permit me to revise the last table of my article, making use of the coefficient 1·03368 derived from Clark, Forde and Taylor's tables. On the basis of the proposed definition of 100 per cent. conductivity and adopting this more correct coefficient, we may deduce that—

1. The resistance of a copper wire of 100 per cent. conductivity, 1 *statute* mile in length, weighing 1 lb., is 861·044 standard ohms at 60° F. Its resistance at 75° F. is 890·03 standard ohms.

2. The resistance of a copper wire of 100 per cent. conductivity, 1 *nautical* mile in length, weighing 1 lb., is 1144·36 standard ohms at 60° F. Its resistance at 75° F. is 1182·9 standard ohms. The following table, then, replaces the last table of my article:—

Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.
105·0	1126·6	102·0	1159·7	99·0	1194·8	96·0	1232·2
104·9	1127·6	101·9	1160·8	98·9	1196·0	95·9	1233·5
104·8	1128·7	101·8	1162·0	98·8	1197·3	95·8	1234·7
104·7	1129·8	101·7	1163·1	98·7	1198·5	95·7	1236·0
104·6	1130·9	101·6	1164·3	98·6	1199·7	95·6	1237·3
104·5	1131·9	101·5	1165·4	98·5	1200·9	95·5	1238·6
104·4	1133·0	101·4	1166·6	98·4	1202·1	95·4	1239·9
104·3	1134·1	101·3	1167·7	98·3	1203·3	95·3	1241·2
104·2	1135·2	101·2	1168·9	98·2	1204·6	95·2	1242·5
104·1	1136·3	101·1	1170·0	98·1	1205·8	95·1	1243·8
104·0	1137·4	101·0	1171·2	98·0	1207·0	95·0	1245·1
103·9	1138·5	100·9	1172·3	97·9	1208·3	94·9	1246·5
103·8	1139·6	100·8	1173·5	97·8	1209·5	94·8	1247·8
103·7	1140·7	100·7	1174·7	97·7	1210·7	94·7	1249·1
103·6	1141·8	100·6	1175·8	97·6	1212·0	94·6	1250·4
103·5	1142·9	100·5	1177·0	97·5	1213·2	94·5	1251·7
103·4	1144·0	100·4	1178·2	97·4	1214·5	94·4	1253·1
103·3	1145·1	100·3	1179·3	97·3	1215·7	94·3	1254·4
103·2	1146·2	100·2	1180·5	97·2	1217·0	94·2	1255·7
103·1	1147·3	100·1	1181·7	97·1	1218·2	94·1	1257·1
103·0	1148·4	100·0	1182·9	97·0	1219·5	94·0	1258·4
102·9	1149·6	99·9	1184·1	96·9	1220·7	93·9	1259·7
102·8	1150·7	99·8	1185·3	96·8	1222·0	93·8	1261·1
102·7	1151·8	99·7	1186·4	96·7	1223·3	93·7	1262·4
102·6	1152·9	99·6	1187·6	96·6	1224·5	93·6	1263·8
102·5	1154·0	99·5	1188·8	96·5	1225·8	93·5	1265·1
102·4	1155·2	99·4	1190·0	96·4	1227·1	93·4	1266·5
102·3	1156·3	99·3	1191·2	96·3	1228·3	93·3	1267·8
102·2	1157·4	99·2	1192·4	96·2	1229·6	93·2	1269·2
102·1	1158·6	99·1	1193·6	96·1	1230·9	93·1	1270·6

Rollo Appleyard.

[The value "·216226" given by Mr. Kempe, to which Mr. Appleyard refers, has as its basis "the resistance at 0° C., of 1 metre of pure, soft copper wire weighing 1 gramme," according to Dr. Matthiessen; this resistance being given as ·1440 B.A. ohm. As this value has only four places of figures, any other value deduced from it can, of course, be accurate only to the same number of figures, consequently the last two figures of the value "·216226" have no significance, and the latter should more reasonably be given as "·2162." It may even be that the last figure of the value ·1440 is only correct within a certain percentage, *i.e.*, it may be that the true value of the resistance represented by ·1440 may be slightly above or below the latter, and consequently that ·2162 may be incorrect to the same degree of possible error. Mr. Appleyard has, we consider, been quite right in taking the value ·2162, in his calculation, as a close approximation.—Eds. Elec. Rev.]

Directory of Railway Officials, 1903.—We have received a copy of the new issue of this useful reference book, which now includes practically all the tramways worked by power in the United Kingdom, and railways in all parts of the globe. The data have been compiled from official sources, and include brief particulars of the length of route, gauge, rolling stock, &c. The personal index has been carefully revised. The volume is too well known and appreciated to need a recommendation to railway and tramway men.

Infirmary Lighting.—The order for the electrical work at the Newcastle-on-Tyne Royal Victoria Infirmary, which is now in course of erection, has been placed with Messrs. Falconar, Cross and Co., of that city. The contract includes the whole of the lighting and power distribution, and also electric bells, telephones, fire alarms and fans. The work is being carried out to the specification of Messrs. Dolby & Williamson, of London.

Round Bulb Glow Lamps.—For window and other decorations, and for all installations where a short bulb is desirable, the B.T.H. Co. supplies a round bulb lamp. This lamp is very neat and compact, and readily lends itself to artistic treatment. The filament is arranged in spiral form, and is supported by a single anchor, which gives mechanical strength to the carbon without casting shadows or interfering with the life of the lamp. The cap is fixed to the glass with a non-hygroscopic material, rendering the lamp suitable for use in damp or exposed places. The round bulb lamp is 3¼ in. long, and 2¼ in. in diameter; and a very high efficiency is claimed for it.

BUSINESS NOTES.

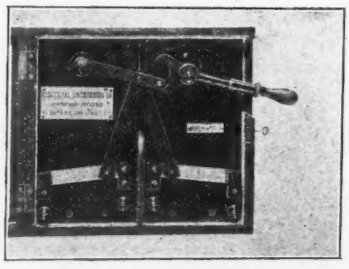
Electrical Wares Exported.

Week ending Aug 12th, 1902.		Week ending Aug. 11th, 1903.	
Alexandria .. .. .. Value	£44	Adelaide .. .. .. Value	£262
Amsterdam	205	Alexandria	10
Auckland	720	Amsterdam	35
Bombay	56	Auckland	200
Brisbane	2,263	Bangkok	173
Calcutta	124	Bombay	210
,, Teleph. mat. ..	68	Calcutta	1,254
Channel Islands	77	Cape Town. Teleg. mat. ..	202
Cheefoo. Teleg. apparatus ..	44	Colombo	51
Christiania	719	Durban	51
,, Teleg. wire ..	74	East London	220
Durban	60	,, Teleg. mat. ..	256
East London	79	Gibraltar	31
Fouchou	25	Grenada	47
Gibraltar	185	Hong Kong	2,132
Melbourne	571	Lisbon. Teleph. cable	60
New York	129	Madras	157
Ostend	10	Melbourne	138
Perth	42	Monte Video	44
Rio de Janeiro. Teleg. mat. ..	560	Penang	38
Rotterdam. Teleg. mat. ..	50	,, Teleg. apparatus ..	70
Sekondi	25	Port Elizabeth	16
Shanghai	263	Rio Janeiro	49
Sydney	809	Rotterdam	38
Wellington	181	Shanghai	141
		Singapore	324
		Sydney	208
		,, Teleg. mat.	27
		Wellington	24
Total ..	£6,725	Total ..	£6,468

Foreign Goods Transhipped.

Gothenburg. Elec. appar. Value	£17	Barbadoes. Teleph. mat. Value	£35
Melbourne. Elec. apparatus ..	53	Fremantle. Elec. mat.	21
Sydney. Elec. fittings	65	Iquique. Elec. goods	43
Total ..	£135	Total	£99

Short's H.V. Switch.—The Electrical Engineering Co. of London, Ltd., of Ormond House, 63, Queen Victoria Street, E.C., is introducing Short's patent high voltage double-pole switch, which has been designed to meet the demand for a thoroughly reliable switch which can be safely operated by inexperienced hands. The parts controlling the switch are mounted on two slate panels, insulated by ebonite dividing pieces, as shown in the adjoining



figure, and are operated by a lever arrangement which allows quickest movement to take place immediately after contact is broken. The switch is designed to give from 3-in. break upwards. The switches are specially suitable for motor starting, being operated by a handle at the side, with the regulating switch screwed on the cover; or as service switches for buildings, &c., being mounted in water-tight cases and operated by a key. The special feature of the switch is that it is absolutely impossible to keep the contacts in an arc-ing position.

German Electrical Machinery Trade.—So far as the year has gone, there has been a noticeable falling off in the importation of foreign electrical machinery into Germany, the returns for the five months ending with May last showing a total of only 322 tons, as contrasted with 634 tons in the corresponding period of last year. On the other hand, there has been an increase in the exports of electrical machinery from Germany—from 4,899 tons in the first five months of 1902 to 5,158 tons in the five months ending May last.

Electrical Motor Vehicles.—With the view of encouraging the use of electrical motor vehicles, the Edison Electric Illuminating Co., of Boston, U.S.A., is preparing a guide which will contain a road map, showing the best routes from point to point, with a list of all accumulator charging stations within a radius of 25 miles from Boston. British station engineers should take note of this.

Miniature Enclosed Arc Lamp.—In our last issue we referred to this lamp as being made by the "Union Electrical Co." This should, of course, read "Union Electric Co."

Automatic Signalling.—According to the *Times*, a length of model railway is on view at the offices of Mr. A. Curphey, 28, Victoria Street, S.W., illustrating the action of a series of signalling devices invented by Mr. R. J. Sheehy, of New York.

Electrical Safety Dress.—In our notice last week of Artemieff's invention, which has been put on the market by Messrs. Siemens & Halske, we omitted to add that the dresses can be obtained in London from the Siemens Electric Appliances, Ltd., 61 and 62, Watling Street, E.C.

Kimberley.—An order for 12 mining locomotives, each driven by a 10 H.P. motor, has been placed by the De Beers Co. with the British Westinghouse Electric and Manufacturing Co., Ltd., London.

British Trade with Canada. — Our contemporary, *Commercial Intelligence*, is making strenuous efforts to induce the Canadian Government to give British manufacturers fair play in placing its public contracts. It appears that Canada alone, of the self-governing colonies, makes no effort to do this, the time limit usually fixed being so short that British firms have no opportunity to tender. Thus these contracts naturally go to the United States of America. Having regard to the close relations between Canada and the Mother Country, there is good reason to hope that our contemporary's efforts will be successful—especially as the Parliamentary Commercial Committee has taken up the matter.

Fire Prevention.—We understand that a protest has been lodged with the Chairman of the British Fire Prevention Committee by the May-Oatway Fire Appliances, Ltd., against the constitution of the jury set up to judge the electrical calls to brigade on Friday last. The objectors allege that the jury selected to deal with this class was unsuitable. Instead of fire brigade officers and electricians, the judges consisted of two insurance surveyors, one borough surveyor, an architect, and Lt.-Colonel Fox, the respected head of the Salvage Corps. The objectors claim that the majority of the members are inexperienced, and that they are unable to assess the precise degree of merit that any one device possesses in relation to the other numerous entries in the same class; they ask that a jury consisting of brigade officers and a working brigade electrician, a consulting electrician, with Col. Fox (one of the present jury), Mr. W. Muir (chief officer of the Liverpool Salvage Corps), and Mr. J. Sheppard (another of the present jury) be appointed as judges, to devote sufficient time to the examination of each appliance, and to subject them all, before a decision is come to, to a practical test, in which the conditions shall be equal for all. At the present time the class is not sub-divided into automatic and non-automatic calls. This, of course, should be done, and the automatics judged in relation to each other, and street boxes, &c., in a class by themselves.

The absurdity of the proceedings of the L.C.C. in the matter of the appointment of a chief officer is fresh in our minds; but, judging from the case referred to above, the example of the L.C.C. appears to be regarded as a wise precedent. We cannot understand why it is not recognised that the official staff of fire brigades should be, first and foremost, electricians. The technical staff of the Government telegraph service is not recruited from the retired classes of the army and navy, nor yet from the ranks of insurance officials and sanitary engineers!

Belgium.—The Provincial Government authorities at Liège lately invited tenders for the conversion of the tramway between Liège and Jemappe to electric traction, but not a single offer was received.

The Telegraph Wire Export Trade.—July proved to be an unusually quiet month as regards the exports of telegraph wire and apparatus connected therewith from this country. The value of the shipments is returned as only £27,340 as contrasted with £76,721 in June last, and no less than £897,601 in July, 1902. The big drop last month makes the year, so far as it has gone, compare unfavourably with the position a year ago, exports during the seven months ending with July last having amounted to only £1,466,194 as against £1,784,786 in the first seven months of 1902.

Printing Works.—Messrs. Palmer & Co., of 42, Castle Street, Oxford Circus, have recently being favoured with instructions to instal at the new works of the Colliery Guardian Co., Ltd., Furnival Street, Holborn, over 300 8-C.P. lamps and 24 H.P. in various sized motors, which are to drive Wharfedale and other printing presses. Beyond this the principal offices are to be fitted with electric radiators, forming a complete and modern installation of electrical power, lighting and heating. The installation has been designed and is being carried out by the contractors' engineer, Mr. J. F. Davie.

Trade Announcements. — The British Westinghouse Electric and Manufacturing Co., Ltd., has found it necessary to open a new branch office in the Sheffield district. This office will be under the management of Mr. W. S. Doran, at York City and County Bank Buildings, Sheffield. All present and prospective clients of the company in the Sheffield neighbourhood are requested to communicate direct with this office in future.

Messrs. Gent & Co., Faraday Works, Leicester, have appointed Mr. Harold Elliot, of 30, Bootle Street, Manchester, to represent them in Lancashire, Cheshire, North Wales and West Riding of Yorkshire.

Disclaimer.—Referring to the report in our issue of the 31st ult. of the proceedings under the failure of Noel Francis Nalder, of 19, Queen Victoria Street, E.C., some confusion appears to have arisen between the name of the debtor and that of Mr. Francis Henry Nalder, one of the managing directors of Messrs. Nalder Bros. & Thompson, Ltd. We are requested to make it clear that Mr. Francis Henry Nalder has not, nor ever has had, any connection whatsoever, direct or indirect, with Mr. Noel Francis Nalder, nor has he or the firm of Nalder Bros. and Thompson, Ltd., ever had any connection with any of the companies in which Mr. Noel Francis Nalder was interested.

Dissolution.—The partnership hitherto held by Mr. Sidney A. Hunter in the Accessories Manufacturing Co. has been dissolved as from July 31st.

Catalogues and Lists.—A very complete list of electric bells and accessories has come to hand from Mr. G. Braulik, of 217 and 218, Upper Thames Street, E.C. Besides a large variety of bells of the ordinary patterns, the catalogue deals with electric buzzers, relays, tramway bells, watertight bells, mining bells, indicators, batteries, pushes, wires, staples—everything, in fact, that the bell-hanger can require. A special leaflet is allotted to "high-tension current" bells and indicators, for use on circuits at 60 to 500 volts.

The Unbreakable Pulley and Millgearing Co., Ltd., send us a card illustrating their manufactures.

We have received from the Electrical Co., Ltd., of 122—124, Charing Cross Road, W.C., particulars and illustrations of their newest types of oil-cooled transformers for three-phase currents for outputs ranging from 1 to 50 kilovolt-amperes. No artificial cooling is necessary with these apparatus, and the final temperature does not exceed 70°—90° F. above that of the surrounding air after 24 hours' run at full load. The transformers are all enclosed in iron tanks, which can be used in exposed positions, and are of the three-core type with common yokes.

Messrs. John Spencer, Ltd., of Wednesbury, have sent out a very useful pocket knife with two blades; the handle is of steel and has engraved upon it measures of 3 in. with sub-divisions to the $\frac{1}{64}$th of an inch, and also centimetre and millimetre scales.

Messrs. Peirson & Co., of 17 and 18, St. Dunstan's Hill, E.C., have sent us a handsomely-executed illustrated description of the "Joly" system of construction of staircases, roofs, bridges, switchboard galleries, &c., of which they are the sole constructors in this country.

Messrs. Bergtheil & Young, of 12, Camomile Street, E.C., have issued a new price list relating to their "B. & Y." motors for direct current, from $\frac{1}{16}$ to 13 H.P., which are made open, ventilated enclosed and entirely enclosed, in standard shapes and sizes. The list includes starting resistances. Other lists give particulars of their ventilating fans, flexible Zodel-Voith couplings, &c.

Messrs. The Bergmann Electrical Works, of 11, Farringdon Avenue, E.C., have sent us leaflets showing their three-phase generators and motors of various types, and their direct-current "tandem motors" for economical control. A special pamphlet describes the last-named system, which consists essentially in the use of a series and a shunt motor mounted in a common housing, and connected with a controller which gives seven combinations and 28 steps in all. At starting the two armatures and the series winding are in series, and the shunt winding is excited from the mains; at full load the two machines are in parallel across the mains. A separate list describes an electric speed indicator for ships' engines, which is, of course, applicable for similar purposes on land.

The August "Progress Leaflet" of the General Electric Co., Ltd., draws attention to reduced prices for switches, &c., and to the company's special lines of traction supplies. Amongst the latter the principal feature is the "Acme patent splicing sleeve" invented by Mr. R. Humphries, chief engineer of the Isle of Thanet Tramways and Lighting Co., Ltd. The sleeve is in two parts, which are slipped over the broken ends of the trolley wire; the latter are then flattened out with a hammer, and the two halves of the sleeve are pulled together and joined with a screwed brass nipple. The joint can afterwards be permanently soldered up, if desired, at any convenient opportunity.

Messrs. E. Cooper & Co., Ltd., of 86, Leadenhall Street, E.C., draw our attention to their "Cooperite" jointing rings for high pressures and superheated steam, acid or alkaline fluids, &c.

Messrs. W. F. Stanley & Co., Ltd., of Great Turnstile, Holborn, W.C., have issued a leaflet describing their new railway level, which is constructed on a new principle, giving greater strength combined with simplicity.

The British Thomson-Houston Company, Limited, of Rugby, have sent us their pamphlets Nos. 147 and 148, describing respectively their B.T.H. Edison round bulb electric lamps, for which a high efficiency is claimed, and a variety of porcelain insulators, brass cleats and brass connectors.

The Stirling Co., of 53, Deansgate Arcade, Manchester, send us a handsome pamphlet relating to their water-tube boiler, entitled "Economical Steam Raising," No. 12. The pamphlet gives a lucid description of the boiler, with its management, and a quantity of data relating to tests made to determine the efficiency of the boiler. A copy will be sent to anyone applying to the above address.

We have received from the C. W. Hunt Co., of 45, Broadway, New York, leaflets illustrating their steel coal tubs and contractors' tubs, which are stocked in various sizes. Other of their manufactures are industrial railways, coal-handling machinery, hoisting engines, &c.

Henley's Telegraph Works.—We are informed that the Admiralty have entrusted to Messrs. Henley's Telegraph Works an important contract for laying cables and conduits, erecting arc lamps, &c., at the new Gibraltar Dockyards. Messrs. Henley are starting the erection of their additional works at Gravesend, and we understand that, besides the manufacture of cable at the new works, Messrs. Henley intend putting down plant for the drawing of high conductivity copper wire. The business community at Gravesend will greatly benefit by the increase of trade which will be brought about by the influx of Messrs. Henley's workpeople.

Annual Outing.—The first annual outing of the Dartmouth staff of the Urban Electric Supply Co., Ltd., took place on August 1st. The party proceeded by train to Paignton and drove to Haytor Rocks *vid* Totnes and Ashburton. Dinner was served at the Rock Hotel, Haytor. Leaving Haytor, and proceeding over the moors, the next stop was made at Beeky Falls, and Bovey Tracey was reached at 5·30; leaving at 7·30, the 9·10 train for Dartmouth was met at *Torre*, ending a most successful and enjoyable day.

Fire at Glovers' Works.—A small fire occurred last Saturday in an outlying store and auxiliary serving shed belonging to Messrs. W. T. Glover & Co., Ltd. The damage, fortunately, was not of sufficient consequence to affect the output, and is covered by insurance.

Bankruptcy Case.—Last week the public examination of Hermann George Gwinner, of Union Court, Old Broad Street, E.C., was held before Mr. Registrar Hope. The statement of affairs showed gross liabilities £4,106 4s. 9d., of which £3,930 4s. 9d. was expected to rank. There were no assets. The debtor stated that he had been engaged in forming syndicates to promote Bills in Parliament, none of which were passed. In February, 1901, he became manager and secretary of the London and Provincial Electric Construction Co., Ltd., which was formed to promote a Bill for the construction of the Charing Cross and Hammersmith Electric Railway; he was also concerned with the Electric Railways Co., Ltd., formed for the construction of a railway from Paddington to Victoria and the Oval, and an electric railway from the City to the Crystal Palace. Evidence was taken, and the examination concluded.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—At the monthly meeting of the local co-operative society, the proposal to renew the society's electric generating plant excited some discussion. It appeared that energy for power purposes was obtained from the Corporation generating plant, but owing to failure to obtain preferential treatment in the matter of lighting, it undertook this itself.

Barking.—The U.D.C. is responsible for the following curious resolution:—"That the —— Engineering Co. be charged 1½d. per unit for every unit consumed up to 200 in one month and 4½d. for every unit consumed in excess of 200."

Belfast.—At the last meeting of the Corporation it was decided to extend the electric lighting mains to the suburbs of Knock and Sydenham. The extension will cost about £8,300.

The electrical engineer reported a very satisfactory increase in the output for the half-year ending June 30th, 1903, as compared with the corresponding period of 1902, the total units sold being 934,493 against 679,474, or an increase of 37 per cent., the increase in revenue being 29 per cent. The average price paid per unit was 3·066d. as compared with 3·263d. in 1902, or a reduction of about 0·2 of a penny per unit. The increased output is accounted for by an increase in supply for lighting purposes of 24 per cent., and for power purposes of 66 per cent. A resolution was moved:—"That the Committee strongly recommends the Law Committee to consider the desirability of promoting an Electric Power Bill for the district of the city of Belfast in the next session of Parliament, such Bill to contain the clauses now usual in Electric Power Bills as to conditions and prices for supply of electricity, raising of money, &c."

Belgium.—A company has just been formed at Fleurus, with a capital of £4,000, to be known as La Société des Ateliers de Construction, Chauffage et Force Motrice par l'Acetylene.

Bootle.—A L.G.B. inquiry was held on the 6th inst. into the application of the Council to borrow £40,000 for electric lighting purposes. There was no opposition.

The T.C. has sanctioned the expenditure of £13,000 odd, for additional plant required at the electricity station, Pine Grove, and for work in connection with it.

Brighton.—The Committee, at their meeting on July 27th, considered a letter from the British Westinghouse Electric and Manufacturing Co., Ltd., stating that they had made a mistake in quoting the sum of £580 for electrically-driven condensers, instead of steam-driven, in the works at Southwick, and that the price should be £1,400, as quoted in their letter of June 6th, 1903, forwarding their tender for the generating plant. The consulting engineer having reported thereon, the Committee were satisfied that the smaller sum was quoted in error, and accordingly recommended the Council to agree to pay £1,400 as the addition for electrically-driven condensers.

Carnarvon.—The plans of the new electric light works have been submitted and adopted, subject to their being approved by Sir W. H. Preece, the consulting engineer.

Clacton.—The Council has received an offer from a local electrical firm, to supply electricity to the business premises in the centre of the town on condition that the Council takes over the installation after an agreed period of years at cost price.

Clydebank.—A plebiscite of the ratepayers is to be taken to ascertain whether they are in favour or not of the T.C. going on with a burgh electric lighting scheme. This decision is the result of letters of protest which the T.C. received from the largest employers of labour in the district, against the scheme being proceeded with.

Dewsbury.—The accounts for the year ending March 31st last just issued, show that the electricity revenue amounted to £5,434 3s. 10½d. This sum included £5,173 0s. 2½d. for the sale of energy; and £168 14s. 10d. for meter rents, &c. On the expenditure side £1,602 9s. 2d. is put down for the generation of electricity; £84 13s. 1d. for distribution; £256 2s. 11d. for rates and taxes; and £797 14s. 6d. for management expenses. The net revenue account shows an income of £2 661 16s. 11½d., and an expenditure of £2,753 19s. 10d., there being thus a deficit of £92 2s. 10½d., as compared with a deficit last year of £378 5s. 8d. In the balance-sheet the assets are put down at £46,319 0s. 5½d., and the liabilities at £38,971 8s. 4d., showing a surplus of £7,347 12s. 1½d.

Exmouth.—The question of combining a destructor with the electricity works of Messrs. Crompton & Co. has been considered. It is suggested that the following offer be made to Messrs. Crompton:—"That the Council (subject to the approval of the Local Government Board) supply steam from their destructor to Messrs. Crompton's electricity works at 1d. per Board of Trade unit, as measured by the meter controlling the generating set worked solely by the destructor steam, subject to the following conditions: The destructor to work along with the night load of the electricity works; Messrs. Crompton to provide and work the generating set required; the Council pay Messrs. Crompton £10 per annum (subject to conditions to be agreed upon) for the use of the electricity works chimney shaft; and the Council maintain the destructor, and provide all labour and everything requisite for generating the steam, clearing away clinkers, &c.

Friern Barnet.—The U.D.C. has instructed the clerk to apply to the L.G.B. for an extension of the electric lighting prov. order.

Glasgow.—The report of the Electricity Department shows that on the year's working the department is in arrears to the extent of £13 200, after making allowance for depreciation' sinking fund, &c. The following are the details:—Revenue from electricity, £127,000, as compared with £103,000 last year—an increase during the 12 months of £24,000. Generating and distribution cost £57,500, and provision was made for financial charges to the extent of £45,000, leaving a balance of £24,500. For depreciation applicable to the year the committee has, however, written off £37,500, thereby bringing out a net debit balance of £13,200. No alteration will be made in the charges to consumers.

Gloucester.—The E.L. Committee has recommended that a sub-station and plant be erected at the Cross, at a cost of £350, for pressure regulating purposes in the Lower Barton district. It was also decided to recommend that the tramway routes be electrically lighted, and the cables laid at the same time as the traction feeders.

Gosport.—Plans and estimates are being prepared for installing the electric light, in the Clarence Victualling Yard, Priddy's Hard and Forton Barracks.

Gowerton.—The proposed electric lighting scheme has been abandoned through, it is stated, lack of support from the railway companies and public building authorities.

Guildford.—The Guildford Electricity Supply Co., Ltd., has been requested to extend its mains by the main Epsom road to the village of Merrow. It, however, could not comply with the request on account of the expense, except by overhead wires. The B. of T. had no objection to this if the consent of the local authority were obtained. The company accordingly asked permission to erect such wires. It was decided to refer the matter to the County Council, with an expression of the Rural Council's opinion that it was not desirable that electricity should be conveyed by means of overhead wires.

Holyhead.—At a special meeting of the U.D.C. it was decided to enter into a contract with Messrs. Meldrum for the supply of a destructor plant, and with the National Wiring Co. for electrical plant, in connection with the E.L. scheme.

Hull.—On the minutes of the E.L. Committee, Alderman Holder drew attention to the statement that the engineer estimated the value of the ordinary electricity plant at £220,000. The same statement also showed that the actual cost had been £252,546, which latter item he contended should have included £1,785, which was transferred from revenue in 1896, but which was now deducted from it.

Huntingdon.—The Hiram Maxim Electrical Co. having intimated their intention of applying for an electric light prov. order for the town, it was resolved to inform them that the Council intended to apply for a prov. order for the borough.

Ilkley.—The Gas Committee has decided to approve the application of the Empire Electric Light and Power Co. for a prov. order.

London.—Islington.—At the last B.C. meeting a long discussion took place upon a report from the borough treasurer dealing with the accounts of the electric lighting undertaking for the year ending March 31st, 1903. It appeared that a heavy loss was caused to the undertaking by reason of the energy for public arc lighting being supplied, at less than cost price; thereby precluding the provision of a reserve fund for depreciation. The exact cost of production per unit of electricity during the past year was 4·44d., while the charge made to the Council is only 3½d. per unit. The Lighting Committee recommended that the charge be increased to the exact cost of production and maintenance. It was alleged that the borough treasurer had made a mistake as to some of the figures, and in the result the whole matter was referred back for full inquiry. A Special Committee, appointed some time ago to inquire as to overtime, wages, &c., at the electric lighting station, recommended that a chief assistant and distributing engineer be appointed

who shall be directly responsible to the electrical engineer for all distribution work and have the control of the outdoor staff, and that the salary commence at £250 a year, rising by annual increments of £25 to £300. Also that an assistant engineer and works manager be appointed, who shall be directly responsible to the electrical engineer for all works connected with the construction, running, and repairs at the station, and have the control of the indoor staff, and that the salary commence at £200 a year, rising by annual increments of £25 to £250. These recommendations were agreed to, as well as others abolishing "dirty money," laying down that no overtime be allowed to men on the weekly wages list until they had completed their full ordinary time; further, that no overtime be allowed to the clerical staff or electricians, but that, in case of emergency allowances be given for meals.

Hampstead.—The Lighting Committee has recommended, that, with a view to improving the draught of the chimney at the electric lighting station, steam jets be fitted to two of the boilers as an experiment, at a cost of £30.

Woolwich.—As a result of an audit of the accounts of the Woolwich Electric Lighting Co., the Borough Council has benefited by a reduction of £664 17s. 7d. in the purchase price of the undertaking.

Londonderry.—At a special meeting of the Corporation on 31st ult., a motion was passed in favour of issuing mortgages on the rates for the carrying out of the private electric lighting and power scheme, at a cost of £15 000. The L.G.B had sanctioned a loan originally, but the Board of Works vetoed it as a commercial enterprise and recommended the issue of stock. Practically no one took up the stock, hence the present arrangement of mortgaging the rates. The Corporation has an unexhausted borrowing power of £221,000.

Ludlow.—The T.C. has decided to make application to the Local Government Board for powers to borrow £8,250 for carrying out a scheme of electric lighting, and for the purpose of a refuse destructor. The scheme has been prepared by Mr. John Parker, Hereford, and the Corporation has already consulted an expert upon the details, his opinion being entirely favourable.

Milford-on-Sea.—A company has been formed by some of the residents to give a supply of electricity for lighting and power purposes at this pleasant seaside resort. Milford is situate on the Hampshire coast not far from Lymington, and a lovely view of the Isle of Wight is obtainable from the cliffs. In connection with the plant to be installed, the motive power will be obtained from gas engines of Messrs. Crossley's make, and as there is no public supply of gas, producer gas will be used, this plant also being of Messrs. Crossley's design. The contractors are Messrs. Christy Bros. & Middleton, and the consulting engineer is Mr. L. Alwyn, of London.

Nuneaton.—The L.G.B. has sanctioned a loan of £1,200 for electric lighting purposes.

Oldham.—To inaugurate the opening of the new electricity station, the Electricity Committee partook of what was described in the minutes as "a light dinner," the items including 37 bottles of champagne, 30 bottles of wine and whisky, and 475 cigars, the total cost being £57 9s. 9d. When the matter came up for confirmation a member of the council asked what would have been the cost of "a heavy dinner," while another pointed out that it had cost more to wash the dinner down than to pay for it; but the minutes were passed. It will be recalled that the Council recently countermanded numerous invitations which it had issued to an inaugural luncheon, on the score of expense.

Rangoon.—Twelve tenders have been received for electric lighting and traction in Rangoon—eight from Messrs. George Gilliespie & Co., representing Messrs. Kilburn & Co. and Messrs. Crompton & Co., two from Messrs. J. W. Darwood & Co., one from the Brush Corporation, and one from the Rangoon Electric Syndicate.

Reading.—On Thursday of last week the Town Council considered the fact that the contract for public lighting with the gas company expires in October. It was resolved to ask both the gas company and the electric lighting company to submit schemes.

Scarborough.—The T.C. has decided to write to the Scarborough Electric Lighting Co. and ask them to quote a price for the supply of the energy for lighting the drive by electricity, the Corporation to provide the standards and other necessary fittings. At the present moment the Corporation is not committed to any particular way of lighting the drive.

Sheffield.—A proposal has been made as to the utilisation of the spare steam at the Penistone Road destructor, for the purpose of generating electricity for lighting streets in the neighbourhood of the destructor. The estimated cost of the installation of the necessary plant, lights, &c., for lighting 100 lamps would be £3,000, not including the annual cost of maintenance.

Sleaford.—The U.D.C. has agreed to the recommendation that a new engine and dynamo should be obtained at a cost of £754, and a new boiler at a cost of £625. With the public lamps, there are now 3,002 lamps connected, and applications have been received for connecting 226 more. At periods of heavy load when the shops were lighted in addition to the streets, the plant was fully at work, and there was no reserve in case of a breakdown.

Sowerby Bridge.—The Council has decided to circularise the district with a view to estimating the probable demand for electricity.

Spain.—Application has been made for a concession, to put down a plant, to utilise the water-power of the River Guadelope at Pitarque, in the generation of electrical energy for power purposes.

Stockton.—The Committee has reported that a letter has been received from the L.G.B., expressing the opinion that the Council had no power to borrow money to purchase electric motors, to let out on hire.

Stourport.—The U.D.C. has decided to obtain expert advice, as to the advisability of obtaining a prov. order and ultimately supplying electricity in the district, or as an alternative, of obtaining a supply in bulk from the Shropshire and Worcestershire Electric Power Co.

Wallsend.—A proposal to erect a municipal refuse-destructor and E.L. works, was lost by nine votes to eight—in favour of disposing of the rubbish at sea.

Watford.—The Watford Tradesmen's Association has passed a resolution—"That it is desirable that the Watford U.D.C. do not proceed with any further application to the L.G.B. for electric lighting purposes, until an exhaustive inquiry has been made into the whole system, which at present is such a heavy burden on the rates."

Wednesbury.—The Local Government Board has sanctioned a loan to the Corporation of £11,000 for electric light purposes. The loan is to be spread over of a period of 25 years.

Whitby.—At the monthly meeting of the Council it was decided to borrow a further sum of £2,500 for extending the electric lighting undertaking.

Wolverhampton.—The Town Council has decided that, as and from October 1st next, the price of energy for lighting purposes be fixed at 5d. per unit, on a maximum demand for an average of 1½ hours per day, and 2½d. per unit for all energy consumed in excess. This is equivalent to a reduction of 15 per cent.

ELECTRIC TRACTION NOTES.

Belfast.—The secretary of the Belfast Tramways Co. has informed the town clerk that his directors cannot accept the proposed agreement for the compulsory purchase of the system, and must oppose any Bill promoted by the Corporation for such purpose. The Corporation has informed the company that it will proceed in the next session of Parliament with the Bill, of which it will give notice.

Brighton.—On Thursday last week the T.C. decided to apply for a prov. order to construct a double line of tramway from London Road along Preston Road to the borough boundary, a distance of about one mile. Considerable opposition has at times been raised to this proposal, as Preston Road remains the only route out of Brighton which has no tramway laid along it. The whole of the London traffic traverses this road, but as the Preston district which it will serve has no system of communication with Brighton the proposed line is a necessity.

Burton-on-Trent.—The tramways are now in full operation, having commenced running on Bank Holiday. The Mayor (Councillor Roberts) and members of the Corporation together with some of the principal townspeople met at the Town Hall, and "Success to the Undertaking" was given on the proposition of the Mayor, who reviewed the history of the undertaking. He said they had up to the present, spent about £80,000. They had 5¾ miles of track, about half of which was double, and 20 cars costing £550 each, 17 of which would provide a full service. Thousands of people lined the streets and indulged in some cheering when the Mayoress set the first car in motion. The cars were all gaily bedecked with bunting, and were packed to their utmost capacity each journey. A ride on the cars was the chief holiday feature, and many hundreds of people failed to secure seats. By 11.30 it was estimated that 20,000 passengers had been carried. On Tuesday, and again on Wednesday, there was a great rush for the cars, people waiting for hours in the hope of getting a ride. A plebiscite of the borough is being taken on the question of running the cars on Sundays.

Dresden.—We are informed that special authorisation has been issued to the Deutsche Strassenbahn-Gesellschaft, of Dresden, to equip a short section of their existing tramway lines on the Kingsland surface contact system, preliminary, if the results are satisfactory, to its extension over the Dresden tramway system generally. This will be a matter of considerable interest to English Corporations and others who at present have this system under consideration.

Erith.—We understand that a misapprehension has arisen regarding the progress of the U.D.C.'s tramways Bill through Parliament, to which we referred in our issue of July 10th. Although the full amount of capital asked for has not been accorded, the sum of £165,000 has been granted, so far as the matter has gone, and the Bill has not been thrown out.

Holywell.—The U.D.C. will support a Bill promoting the making of an electric tramway from Sandycroft to Buckley and Hawarden.

Kilmarnock.—Negotiations have been entered into with the burghs of Kilmarnock, Troon, Irvine, Kilwinning, Saltcoats, and Ardrossan, for the purpose of making a joint application for a prov. order to provide an electric tramway system for the district. The proposal is meeting with considerable favour.

Leeds.—We mentioned recently that Mr. Hamilton, manager of the electric tramways, had declined the offer of the Birmingham Corporation to take charge of its tramways. In order to retain Mr. Hamilton's services, the Leeds Tramways Committee offered to raise his salary from £900 to £1,200 per annum, with further increases in three years to £1,500; the Council, however, last week refused to grant the increase, and Mr. R. A. Smithson, chairman of the Committee, has tendered his resignation. Both he and, still more, Mr. Hamilton, have good ground for indignation at the course adopted by the Council, whereby Mr. Hamilton is deprived of both chances of advancement.

London United Tramways. — The recent proceedings at the West London Police Court, where the London United Tramway Co. took action against two of its employés, have drawn public attention to the feeling of discontent which prevails among the men generally. The men had been discharged because they attended a midnight meeting held some three weeks ago to form a branch of the Tramway Workers' Association. The effort to form an association seems to have failed, owing to the drastic rule which prohibits attendance at a meeting under pain of dismissal. This is regarded by the men as an unwarranted interference with the liberty of the subject, and the right to dispose of their own time as they please.

Last week Sir Herbert Jekyll, assistant secretary of the B. of T., conducted an inquiry into the scheme of the London United Tramways Co. for an extension of their system to various parts of Middlesex, including Sunbury, Southall, Hanworth, and other districts. The scheme had been sanctioned by the Light Railway Commissioners, and came before the B. of T. for confirmation. An amendment was advanced by the Middlesex County Council, based on a recommendation by Colonel Yorke, to vary the provisions of the Order so as to require that the minimum width of the roadways along which the trams pass shall be 32 ft. instead of 24 ft. This gave rise to an important discussion. It was stated that if a minimum width of 32 ft. were insisted on, the company would have very seriously to consider whether they could proceed with the Order. Mr. Moreton Smith, on behalf of several District Councils, also urged that in respect of these roads the Middlesex County Council had no *locus standi*, and protested against the attempt to override the agreements of the District Councils.

London.—A complete breakdown of the L.C.C. electric tramways, on Tuesday last, caused great inconvenience to the public, especially as the rain was falling in torrents. The omnibuses, which have become scarce since the new system was inaugurated, were naturally unable to cope with the crowds. Unfortunately, a dislocation of the electric service interrupts the old horse-car service, as well as the cable service over Brixton Hill, wherever the different systems are interlaced. The beauties of the conduit system are more apparent to the County Councillors as they drive homewards than to their miserable electors trudging home through the floods.

Manchester.—The refusal of the Corporation to carry passengers on the electric cars up the steep gradient from Chestergate into St. Peter's Square, has evoked bitter complaints from the Stockport public; in order to get over the difficulty an order has been placed to equip a large number of cars with the Westinghouse magnetic brake, which will be put in service on the Stockport route, and it is hoped that the cars so equipped will be able to safely negotiate the heavy gradient.

Mersey Railway. — The Mersey Railway Co. have found, as a result of the electrification of their line, that it is possible, without interfering with the efficiency of the service, to effect various economies in the supervision expenses. Hitherto each station has, according to the *Liverpool Mercury*, been under the charge of an inspector, at a wage of 32s. to 35s. a week, whose duty it was, among other things, to despatch the trains with regularity; but as this work is now done by the crews of the electric trains, it is considered that all the necessary platform control can be given by a station foreman at a wage of 27s. a week of seven days, and this change is about to be made general on the line. Another economy is to be the gradual introduction of youths as junior conductors, to attend to those intermediate cars where the opening and closing of gates and signalling to the guard is all that is required. These junior conductors are to be paid 10s. a week of six days, instead of the 18s. now paid to baggage and all other conductors. No change has been made in the remuneration of the experienced officials filling the positions of drivers, guards and signalmen.

Paris Underground Electric Railway.—A terrible disaster took place on Monday night on this railway, no fewer than 84 passengers being killed. It seems that a motor hauling a train broke down, and the train was pushed by a second train—both having been emptied of passengers—towards the terminus. On the way both trains caught fire, and eventually the blazing trains came to a standstill, and were abandoned by the officials. Meanwhile, a third train was stopped, 300 yards in rear of the first two, at the entrance to a station (Gare des Couronnes); the passengers alighted on the track, and, seized with panic, fled for their lives, but in the dense smoke most of them lost their way, and were unable to find the exit. It was at first supposed that but few lives were lost, and it was not until the following morning that the full extent of the hideous calamity was discovered, as the tunnel was unapproachable owing to the heat and smoke.

The first break-down occurred in the open, and had not the driver unwisely decided to enter the tunnel, in the hope of reaching the terminus, the danger would have been trifling. Obviously the loaded train ought not to have been allowed to approach the burning trains—how such a thing could be permitted is quite incomprehensible.

The bearing of the disaster upon the working of the London electric railways deserves serious consideration. The Liverpool accident should have sufficed to give warning of the danger, and the Paris Metropolitan Co. ought to have guarded against it; the utmost precautions must be observed by our own officials, and the use of combustible materials of construction rigorously avoided. We believe, however, that the construction of the tube railways with separate tunnels is an important factor in ensuring the safety of passengers.

Portsmouth.—Mr. E. Rotter, electrical engineer for the Portsmouth Corporation Tramways, has submitted to the Committee the following statement showing the working out of the completed contracts, Nos. 1 to 6:—Electric cars, £49,270 17s.; station plant, £31,936 10s. 6d.; power buildings, £12,437 7s. 1d.; permanent way and feeders, £218,554 6s.; overhead lines, £27,500; car-sheds, £17,847 10s. 8d. The grand total amounts to £378,425, of which £12,643 11s. 10d. is still outstanding.

Southport.—On August Bank Holiday the Southport Corporation tramway system scored a record by taking £159 8s. 4d. during the day on the cars, while the Southport Tramways Co. carried 24,000 passengers.

Wallasey.—At the monthly meeting of the U.D.C., Dr. Napier said that the Tramways Committee had decided to proceed with the extension of the system to serve certain new districts. The proposed extensions would cost £52,100, but the cost of the various road-widenings would be about £101,000. Car-shed extensions would be needed which would cost £4,000, and 20 new cars would cost £12,000, making a gross total of £169,100. The scheme had been the subject of a report by Mr. W. H. Travers, the surveyor, and the Committee had adopted it. The minutes containing the Committee's decision were confirmed.

Walsall.—It appears that, according to the present arrangement of the tram lines, now nearing completion, when the British Electric Traction and the Walsall systems meet at a certain point there will be a serious block. This is a matter for arrangement between the Corporation and the British Electric Traction Co., and it is stated that by a mutual agreement the difficulty can be got over by the construction of a loop line, which would be the means of giving complete intercommunication between every part of the town and district, and the towns of Wednesbury and Darlaston.

Wednesbury.—As a result of the negotiations which have been going on for some considerable time between the Corporation and the Tramways Co., terms have now been arranged for the electrification of that portion of the South Staffordshire line between Wednesbury Bridge and the White Horse Hotel. It is hoped that the work will be completed before the New Year.

Wolverhampton.—The Tramways Committee is experimenting with a petrol motor omnibus for public traffic. As in the former experiments of the Committee, the omnibus is the property of the makers, and has been lent for the occasion. When will this Committee of flighty experimentalists learn common-sense, and abandon its trifling?

TELEGRAPH AND TELEPHONE NOTES.

Glasgow.—At a recent meeting of the sub-committee on finance of the Corporation Committee on telephone service, the financial statement for the year ending May 31st, was submitted. It stated that the total revenue was £55,728, and the working expenses £15,967, making the net revenue £39,761, out of which the following requirements had to be met:—Interest £6,642, sinking fund £5,806, Post Office royalty £3,405, and terminal fees £1,497, a total of £17,352, leaving a balance of £22,408. Adding the surplus of £398 from the preceding year the balance is £22,807, which is dealt with as follows:—Proportion of rental applicable to year 1903-4 carried to suspense account, £20,714, leaving a surplus of £2,092 which the sub-committee recommend should be carried to a reserve fund. The expenditure on capital account for the year was £78,556.

The Pacific Cable.—In the House of Commons recently the Chancellor of the Exchequer, in reply to a question by Sir M. Hicks Beach, stated that the accounts showed a total net expenditure, charged to the Exchequer grant, up to March 31st last, of £91,437 4s. 11d. This charge covered interest and also the working expenses of the cable so far as they exceeded the traffic receipts. It included nothing for sinking fund, as the first instalment of the annuity for repayment of the money borrowed for construction does not become payable till December next. The share due from the contributing colonies in respect of the expenditure to March 31st last is £65,374 5s. 4d., and payment will be claimed from the colonies as soon as the Board's accounts are received.

(*Continued on page* 267.)

WIMBLEDON ELECTRICITY WORKS.

The popularity of Wimbledon as one of the residential suburbs of London may be judged by the fact that, between 1893 and 1903, its population has increased from 28,000 to 46,000 inhabitants. Practically the whole of the town is of a residential character, there being no important industries, and a large proportion of the inhabitants travel to London daily.

The town is unique in respect of its very remarkable development of street lighting by electricity, as will be shown later on.

The question of providing an electricity supply for Wimbledon was first raised in 1894, and in 1897 the Council obtained a provisional order; Mr. A. H. Preece was appointed consulting engineer, and reported on a scheme. Mr. Preece's designs provided for a combined refuse destructor and electricity works; they were approved by the Council, and tenders were invited for carrying out the work. The original scheme provided for 8,000 8-c.p. lamps, but this number was far exceeded during the first year's working, no fewer than 16,000 lamps being connected during that period. The high-pressure alternating system was adopted, and a site was chosen for the station close to Wimbledon Park railway station, about 1¼ miles from the centre of the area of supply.

The buildings are constructed of brick. The engine room measures 68 ft. × 82 ft., and has a dado of "Crystopal" tiles built round the walls. The boiler house measures 116 ft. × 52 ft. The general offices for the engineer and staff, and the stores, adjoin the engine room. All the rooms are well lighted and ventilated.

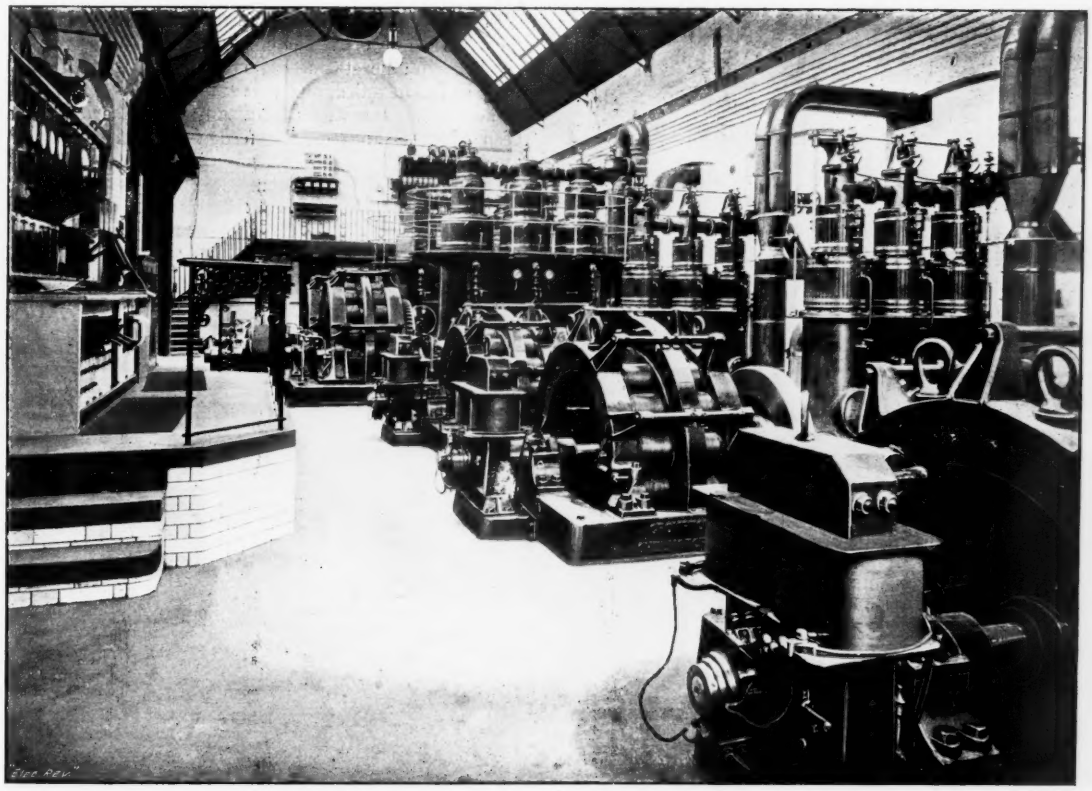
The refuse destructor house adjoins the main building, and measures 44 ft. by 82 ft.; next to it are the sewage pumping works of the Council, which will no doubt be driven by electricity in the near future.

Important extensions are now in progress, to the designs of the electrical engineer, Mr. H. Tomlinson-Lee, which, when completed, will practically double the capacity of the station.

Electricity and Destructor Works, and Siding.

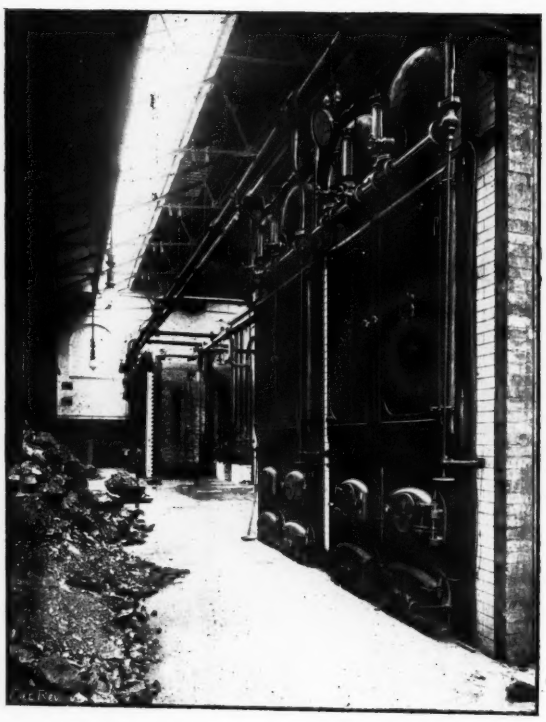
The boiler-house at present contains five Babcock and Wilcox boilers, rated at about 1,700 h.p. A new 500-h.p. boiler is in course of erection in this boiler-house. Each boiler is connected by two 4-in. branches with the main range, 7 in. in diameter, which runs the whole length of the boiler-house, and is fitted with valves constructed by Messrs. Fletcher Bros., of Ashton-under-Lyne. Each boiler is provided with mountings of Messrs. Hopkinson's make, and a B. & W. superheater; the latter are continually in use, the steam being superheated to between 450° and 500° Fahr. The firing is done by hand, best Welsh coal being used.

The water for the boilers is derived at present from the town mains, and is of a rather hard quality, only a small quantity of condensed water being used. The water is fed to the



Interior of Engine Room.

boilers by means of two Worthington duplex pumps, rated at 2,500 gallons per hour each. A Weir direct-acting steam-driven feed pump is about to be installed, capable of delivering 5,000 gallons of water per hour. Duplicate suction and delivery pipes for the pumps, and duplicate steam ranges, are provided. There is a storage tank of about 4,000 gallons capacity, and the provision of an additional tank of 30,000 gallons capacity is contemplated; a Green economiser of 128 tubes is also about to be erected.



Babcock & Wilcox Boilers.

At present coal is brought to the station by road, but a siding is being built from the main line of the L. and S. W. Railway, by means of which the coal trucks will be brought up an incline to a combined turn-table and weigh-bridge, from which they will be run on an elevated track right over the boiler house, delivering the contents on the boiler house floor in front of the boilers.

The chimney shaft at present in use is situated in the boiler house. It is octagonal in shape, on a square base, and is 96 ft. in height, with an internal cross-section of 20 sq. ft.

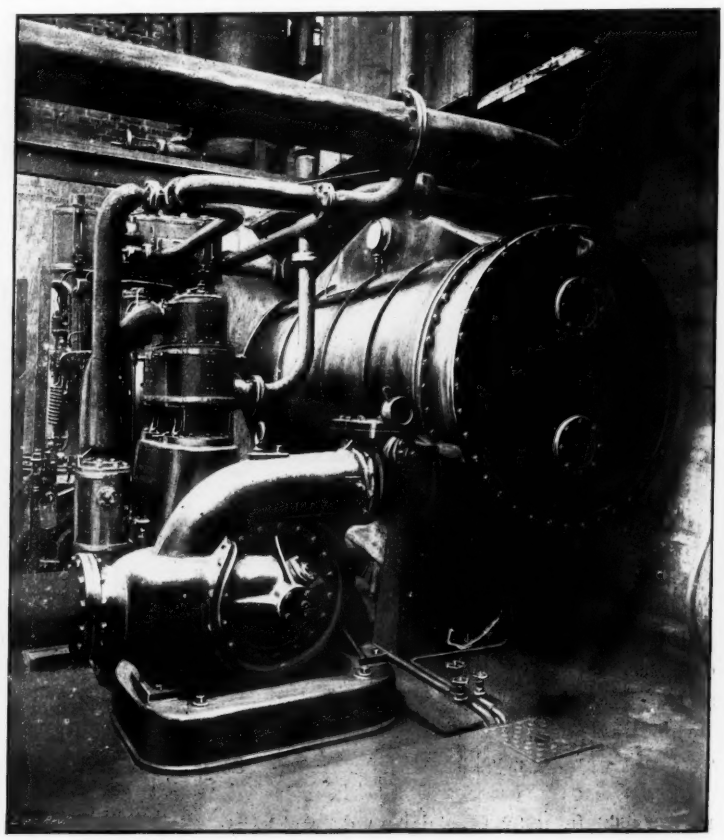
The destructor plant consists of four Beaman & Deas cells connected with two B & W. boilers, similar to those in the coal-fired boiler house; these boilers are entirely separate, and form two combinations with the destructor cells. There is an incline from the roadway on to the tipping platform alongside the destructor house. The refuse is tipped here, and then hand-fed into hoppers above the furnaces, from which it is admitted to the latter. About 30 tons of house refuse and 15 tons of sludge from the adjoining sewage works are destroyed daily, and this is considered to be a very satisfactory result.

From the main steam range in the boiler house two main steam pipes are taken into the destructor house, where they form a ring, to which each of the destructor boilers is connected. From this ring two branches are taken through the dividing wall to each engine. This arrangement enables the engines to be supplied from either side of the steam ring. The whole of the boilers, steam and exhaust pipes are covered with Messrs. A. Haacke's patent fibrous packing; the main steam branches to the engines, and the exhaust pipes, are further covered with blue steel sheet, which gives them a very neat appearance.

A main cast-iron exhaust pipe runs the whole length of the engine room to a condensing pit situated in the boiler house. The condensing plant is provided with a vertical exhaust pipe to atmosphere, 24 in. in diameter, at the base of which an atmospheric automatic exhaust valve of Messrs. Fletcher Bros'. make is fitted. The whole of the condensing plant was supplied by Messrs. Alley & MacLellan, of Glasgow, and is of the surface condensing type. The condenser has 1,927 tubes, with a cooling surface of 3,400 sq. ft. The air pumps are of the "Edwards" type, and, like the circulating pump, are steam driven. The plant is capable of dealing with 35,000 lbs. of steam per hour; the condensing water is obtained from the River Wandle, which is about 300 yds. from the works, and is returned to the river after passing through the condenser.

Before the exhaust steam passes into the condenser, it goes through a Holden & Brooke oil separator, which extracts the oil which passes with the steam from the engine cylinders. In connection with this oil separator there is installed one of Messrs. Holden & Brooke's vacuum traps, which effectually deals with the trouble generally met with where feed water is derived from condensed steam, namely, the presence of oil. The chief engineer speaks very highly of this trap; he states that it has never failed in its duty since it was installed, and that it fully comes up to what the makers claim for it, as practically no trace of oil has he been able to find in the feed water derived from the condenser.

The generating plant consists of five sets of Crompton alternators, each driven by a Willans engine, three being of 120 KW. capacity each, and two of 350 KW. capacity each. The alternators are of the Crompton-Brunton type, with



Alley & MacLellan Condensing Plant.

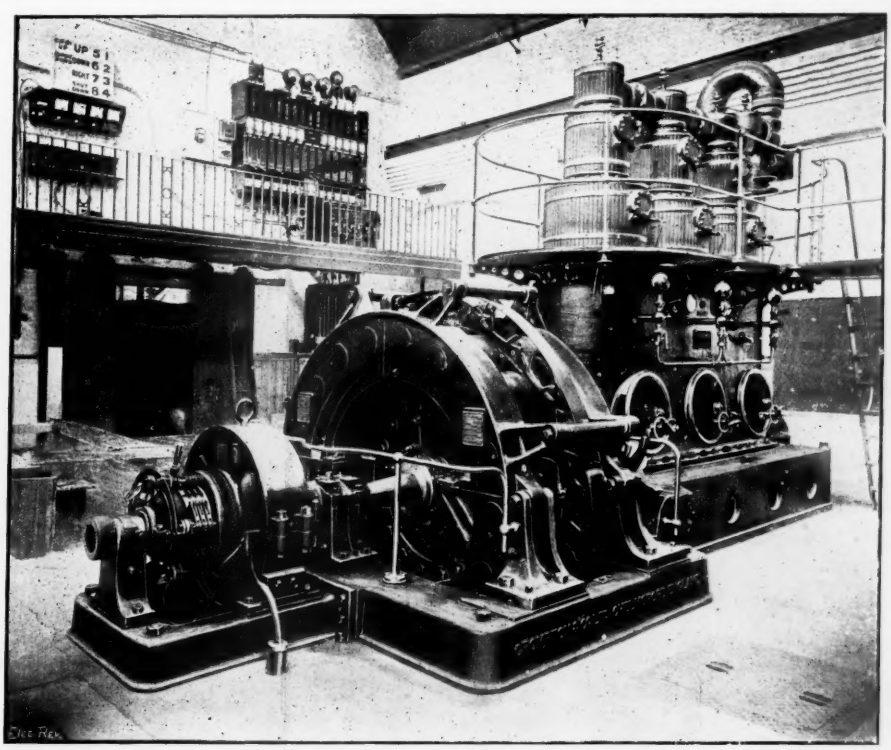
disc armatures. The smaller machines are driven at 350 r.p.m., and the larger ones at 333 r.p.m. All the machines work at 2,250 volts at full load, at a frequency of 50 cycles

Exterior of Works, and Staff Quarters.

per second. Each alternator is provided with its own exciter, carried on an outboard bearing, those of the smaller sets being of the two-pole and those of the larger sets being of the multipolar type.

All the engines are of the well-known Willans three-crank compound type, and are coupled direct to the alternators by flanged fly-wheel couplings.

The high-pressure switch gear originally installed, and visible in our general view of the engine room, was made by Messrs. Cowans, Ltd. Owing, however, to the rapid growth of the undertaking, this was found to be unable to effectually and safely deal with the heavy currents that had to be transmitted, and it was decided to instal a new switchboard. The order in this instance went to Messrs. Ferranti, Ltd., of Hollinwood. The new board is mounted on a gallery at one end of the engine room, at a height of 12 ft. from the floor level, and is so arranged that it can be extended to meet all the future requirements of the station. It at present consists of 15 standard 300-ampere panels, of which six are provided for the generators, two for the interconnector switchgear, and seven for the outgoing feeders. Over the top of the board there are fixed three high-pressure bus-bars, and these are arranged in such a manner that any machine or feeder can be connected or disconnected by means of expansion plugs. The machines can thus be run either separately, or in parallel, as desired. All the high-pressure mains are of the concentric type, and are run with the outer earthed. Each feeder and generator is provided with a separate ammeter and with duplicate fuse contacts. Special attention has been given to the exciter switchgear, which is mounted in the usual way in front of the generator panels. The switches and contacts are of heavy design, to prevent any possible derangement of the exciting current. The alternating current instruments are of the "Ferranti" type, and the continuous current instruments are of Messrs. Nalder Bros. & Thompson's make. All the current passing to the feeders goes through one main watt-hour meter of the Westinghouse type, seen on the left hand of the switchboard in our views. A separate meter is provided for the street lighting supply. The usual synchronising gear and accessories are provided.



Willans-Crompton 350-kw. Steam Alternator.

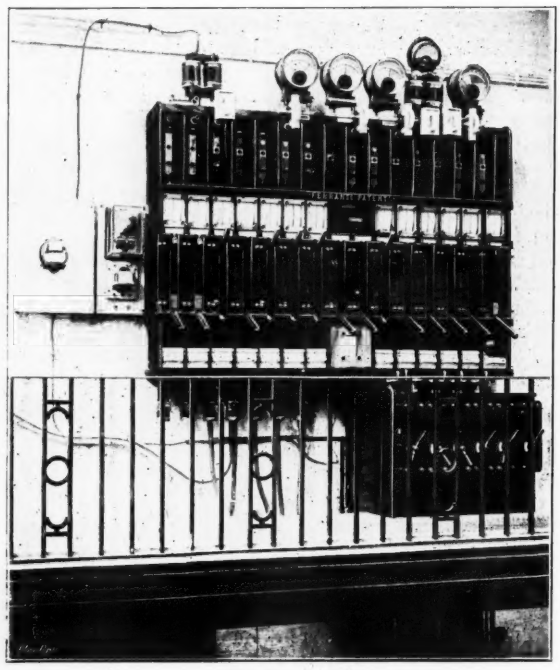
The whole of the machines and mains at the station were safely and effectually transferred on to the new switchboard a few weeks ago, without the continuity of the supply being in any way interrupted.

The high-pressure trunk mains leaving the station are of the concentric type, and are paper-insulated and lead-sheathed; the sectional areas are ·1 sq. in. and ·032 sq. in. These mains were supplied and laid by Messrs. Henley's, and they are drawn into earthenware ducts. The trunk mains after leaving the station run to three main centrally-situated sub-stations, from which high-pressure feeders are taken to some 35 outlying transformer sub-stations, as shown in the plan on p. 267. The three main sub-stations are equipped in such a manner that they can be interconnected at will, and some of the smaller sub-stations are similarly constructed.

The street lighting of Wimbledon is unique, inasmuch as it is entirely controlled from the the generating station. One trunk main is run to supply the various street lighting sub-stations, these being kept entirely separate from the private lighting sub-stations. From the former sub-stations a low pressure 3-wire distribution system, with 440 volts across the outers, supplies some 1,150 street lamp-posts. Each post is surmounted by two 16-c.p. incandescent lamps, in fittings made by the Reason Manufacturing Co., of Brighton. At dusk the street lamps are run up on a separate machine, in such a manner that every lamp in the district comes up to full pressure simultaneously, thus avoiding the necessity of switching the lamps on in batches, as is generally done. When the lights are up to full pressure, the street lighting machine is paralleled with the private lighting machines at the station, and the plant is so run until dawn, when the operation is reversed, the street lighting machine being separated from the private lighting machines, and gradually shut down.

The transformers installed in the sub-stations vary from 10 to 50 kw. in capacity, and are of the British Electric Transformer Co.'s, Johnson and Phillips', and John Fowler & Co.'s make. All the switchgear in the sub-stations was

supplied by Messrs. Cowans, Ltd. Owing to the very extended area of the district, the station pressure is found to be considerably in excess of the local circuit requirements in the vicinity of the works. To overcome this difficulty, two transformer-boosters are placed in connection with the feeders supplying these circuits, and are used to regulate the pressure as required.



Ferranti Switchboard.

Although the street and private lighting systems are entirely distinct, provision has been made whereby the two may be inter-connected in the event of one or the other failing. By this means a duplicate system is provided for both purposes. There is no extravagance in thus separating the two systems, as otherwise duplicate mains would have to be laid; and it has been found that the present arrangement works remarkably well in practice.

Practically every street in the town is supplied with a low-pressure private lighting distributor in addition to the public lighting mains, and the remarkable development of the street lighting system may be gathered from the plan which we reproduce on this page. Every one of the dots upon this plan represents a lamp-post fitted with two 16-c.p. lamps. The whole of the town is lit with glow lamps; arc lighting has not made much headway, only four posts at present being erected, and these only for experimental purposes.

All the low-pressure distributors for street lighting are three-core V.I.R.-insulated lead-sheathed and armoured cables; for the private lighting distribution they are concentric paper-insulated, lead-sheathed and armoured, and are laid direct in the ground. The street lighting mains were supplied by Messrs. Henley's, and the private lighting mains by Messrs. Henley's and Messrs. Callender's.

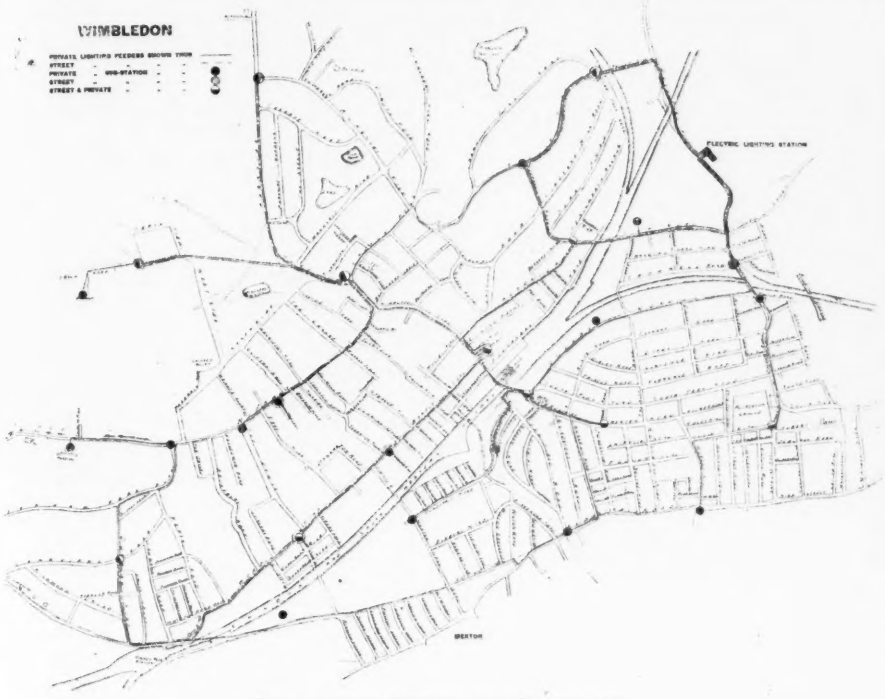
The Council has just secured a provisional order for supplying electrical energy in the Parish of Merton, in the Rural District of Croydon, and in view of this and the rapid increase in the demand in Wimbledon itself, it has been necessary to prepare plans and specifications for considerable extensions to the works. These have been drawn up by the electrical engineer, and provide for the erection of a new boiler house and chimney shaft and the addition of workshops. The shaft will be 175 ft. high from the ground level, with an internal diameter of 10 ft., and is already in course of erection. The new boiler house, when erected, will be parallel with, and adjoining the existing boiler house. It will measure 51 ft. by 117 ft., and will provide accommodation for boilers of about 3,000 h.p.

Wimbledon: Plan Showing Positions of Public Lamps.

Behind the boilers there will be installed economisers of 640 pipes, and the flues are being so constructed that the

gases from both the existing boilers and the boilers in the new boiler house can be carried into the same shaft. The installation of a water-softening plant and a large storage tank is also under consideration.

A new generating set, consisting of a British Thomson-Houston alternator, coupled direct to a Browett-Lindley three-crank compound engine, is under construction. This set will have a normal output at full load of 625 KW., and when installed will complete the equipment of the main bay of the engine room. Space is already available in the extension bay for further generating plant of 4,000 KW. This bay was originally built for the accommodation of traction plant, but it will not now be required for this purpose.



PLAN SHOWING FEEDERS AND SUB-STATIONS.

It is anticipated that the extension to Merton will have as rapid a growth as that experienced in Wimbledon; how rapid this has been may be seen from the following statistics:—

	Consumers.	Lamps, 8 C.P.	Public lamps, 8 C.P.
Date supply commenced, July 17th, 1899	140	3,495	—
Period ending March 31st, 1900... ...	253	13,965	2,708
Year ending March 31st, 1901	459	28,179	4,100
Year ending March 31st, 1902	705	33,504	4,100
Year ending March 31st, 1903	978	49,481	4,486

Year ending	Mar. 31, 1900.	Mar. 31, 1901.	Mar. 31, 1902.	Mar. 31, 1903.
Units sold ...	154,450	644,421	785,815	1,011,998
Maximum demand in KW.	198	367	510	603

The total mileage of mains laid in the town is 126, of which about 33 miles are high-pressure feeders, the remainder being low-pressure distributors for street and private lighting.

The analysis of the accounts for the year ending March 31st, 1903, will be found on another page of this issue, and they show that the Wimbledon undertaking has established itself on a sound profit-earning basis. The load factor during the four years the works have been in operation has been as follows:—1900, 12·5 per cent.; 1901, 20·04 per cent.; 1902, 18·05 per cent.; 1903, 19·15 per cent.

The maximum demand system is at present in operation for both public and private lighting supply, the rate of charging being 7d. for the first hour's use of the maximum demand per day and 2d. afterwards. For power and heating purposes a flat rate of 2d. per unit is charged.

The majority of the meters on the circuits are of the "Hummel" type, supplied by the Electrical Co., Ltd. These meters give every satisfaction, and it is worthy of note that out of over 1,000 installed on consumers' premises, only one or two are reported as faulty or stopped each quarter; on one or two occasions the whole of the quarterly readings have been taken without a faulty meter being found. A few Shallenberger meters are also installed. The maximum demand indicators are of the "Reason" and "Schattner" type.

With the exception of the three main sub-stations already referred to, all the transformer sub-stations are of the street tank type. These have been found very dangerous and inconvenient, and Mr. Lee has prepared plans for the gradual conversion of the whole of them into roomy underground sub-stations. This work has already been commenced.

The offices which were built in connection with the works have over them a house of commodious proportions. This, in the first place, was used as a residence by the mains foreman. Mr. Lee, however, recognising that the house offered better facilities for the accommodation of the technical staff of the station, made arrangements whereby the staff were provided with quarters, which have proved not only beneficial to them, but, perhaps in a greater degree, to the Council.

There are six assistants residing in the building. Each is provided with a private bed-sitting room, and there is a large dining room common to all. The meals are prepared by a housekeeper, who also supervises the ordinary domestic duties.

On our visit to the station we had an opportunity of inspecting these apartments, and we were agreeably impressed with the air of comfort that pervaded everything. The arrangement has been found to work very satisfactorily indeed. The furniture is plain but substantial, and was procured out of a loan raised by the Council.

In conclusion, we have pleasure in expressing our obligation to the Council's electrical engineer, Mr. H. Tomlinson-Lee, for his kind assistance in the preparation of this article, and for facilities to photograph the plant.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 262.)

Post Office Telegraphs.—According to the Postmaster-General's report, abstracted in the *Times*, the number of telegrams sent over the Post Office wires in the past year was 92,471,000, showing an increase of 2·3 per cent. over the number for 1901-2. The receipts for these amounted to £2,838,429, or an increase of £16,563. Every class of telegram shows an increase, and the number of inland and foreign telegrams are the highest ever recorded. Ordinary inland telegrams in the month of June, 1902, exceeded in number those sent in June, 1901, by more than half a million, this being due, no doubt, the report states, to the illness of the King and the postponement of the Coronation. On June 23rd no fewer than 201,559 telegrams passed through the Central office, on June 24th 311,039, and on June 25th 314,126. The largest number previously recorded was 199,155 on the day before the funeral of Queen Victoria. The average weekly number of words in Press telegrams during the year has been 14,890,712 as against 14,344,833 in 1901-2 and 16,035,602 in the previous year.

On the subject of wireless telegraphy, the Postmaster-General refers to the communications which he has had with the other Government departments concerned, and with Mr. Marconi, and the two companies which possess his rights. He has provided for the Marconi company a private wire from Poldhu to Falmouth on the usual rental terms; and he has explained to the company that, before the Post Office can act for the company as agent, the company must satisfy him that it is in a position to carry on its business and transmit messages from one side of the Atlantic to the other.

Until he is satisfied in this direction he states that he will not be justified in accepting messages and collecting charges from the public. It has not been possible as yet for the Post Office to arrive at a definite decision on the question of the establishment of ship signalling stations on the coasts of the United Kingdom for wireless telegraphy.

The length of the telephone trunk lines in use was about 46,740 miles, containing about 93,000 miles of wire. The capital expenditure on the purchase and development of the trunk line system up to March 31st last was £2,091,417, including an expenditure during the year of £224,986.

Great progress has been made with the development of the Post Office telephone system in London. In addition to the Central Exchange, which was opened on March 1st, 1902, six other exchanges have been opened during the year 1902-3, and four others are in an advanced state of construction. The total number of subscribers' telephones working in connection with these exchanges on March 31st was 9,122. The number added during the year was 8,628, and it is believed that this number has not been exceeded during the first year of working of any other local telephone system.

The Postal Telegraph Clerks' Association has issued a reply to the Postmaster-General's statement to the Unionist members of Parliament who waited on him in regard to the alleged reduction by £30 of the maximum salary of London telegraphists. The Association is unable to accept the Postmaster-General's view of the matter, and it reiterates the charge of breach of faith brought against the Department.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Fao-Bushire	July 28, 1903	
Bolama-Bissao	Aug. 4, 1903	
St. Jacques-Haiphong	Aug. 3, 1903	Aug. 5, 1903
Antigua-Guadeloupe	Aug. 9, 1903	
Jamaica-Colon	Aug. 11, 1903	
Landlines.		
U.S. of Colombia:—Landlines to Dagua	July 14, 1903	Aug. 8, 1903
To Puerto Barrios	July 28, 1903	
Rome-Pera	Aug. 8, 1903	

Wireless Telegraphy.—The difficulties met in establishing wireless telegraphy satisfactorily in Somaliland continue. According to the *Pall Mall* the crew of experts from H.M.S. *Vernon*, specially lent for the purpose at the commencement of the recent operations, made the discovery that the soil was so dry, and the sand so plentifully mixed with insulating mica grains, that the current could not be brought to earth with any strength. The result was that the signals were weak and almost useless. The expedient of immersing the earthplates in wells was tried, but with little benefit, and the Admiralty experts state that successful wireless telegraphy in the Somali country is out of the question. A squad of Royal Engineers are on their way there now to try what they can do, and it is expected that in the end they will establish a field wire.

Wireless Telegraphy in the U.S. Navy.—Contrary to the impression conveyed by recent reports as to the questionable utility of wireless telegraphy in connection with our naval manœuvres, owing to interference from land stations, the U.S. squadrons appear to have experienced its usefulness. It appears that the *Olympia*, of the defending squadron, considered herself captured under the rules of the manœuvres by the superior force of the attacking squadron, but before surrendering she sent a wireless message summoning the rest of the defending squadron, which was at the moment 25 miles distant. Her consorts, promptly responding to the message, captured the hostile fleet, which, had the *Olympia* not been equipped with wireless telegraph apparatus, would have reached the anchorage at Winter Harbour, and would have won.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—August 26th. Lamps, oils, meters, for the U.D.C. See "Official Notices" to-day.

Belgium.—August 17th. Tenders are being invited by the Provincial Government Authorities in Liège for the concession for the construction and working of an electric tramway on the overhead conductor system between Liège-Guillemins and the village of Angleur. Particulars may be obtained from, and tenders are to be sent to, Le Gouvernement Provincial, Liège.

Bexley.—August 21st. Street lamps and fittings for the U.D.C. See "Official Notices" August 7th.

Bexley.—August 22nd. Wiring buildings for the U.D.C. See "Official Notices" to-day.

Cleckheaton.—August 22nd. Cables for the U.D.C. See "Official Notices" to-day.

Edinburgh.—August 26th. Arc lamps for public lighting. See "Official Notices" to-day.

Germany.—Tenders are at present being invited by the Municipal Authorities of Tubingen for the supply of a new steam engine and dynamo for the municipal central electric lighting station, at an estimated cost of £2,500.

The Municipal Authorities of Riesenburg, Western Prussia, are inviting tenders for the establishment of a central electric lighting station in the town.

The Municipal Authorities of Wangen (Wurtemburg) are at present inviting tenders for the concession for the electric lighting of the public streets and buildings.

Grimsby.—The Corporation wants tenders for a motor balancer and switchboard, and underfeed stokers to four boilers. See "Official Notices" August 7th.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Hungary.—August 31st. Tenders are being invited until the 31st inst. by the municipal authorities of Beszterczebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—October 6th. Four 5,000-H.P. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales for an additional generating set of 1,500 KW. for their tramway power station.

Northampton.—August 15th. Steam dynamos, battery, switchboard, equipment of trolley lines, feeders, cars, permanent way, buildings, car-sheds, piping, condenser, &c., for tramways power station. See "Official Notices" July 31st.

Pietermaritzburg.—September 7th. Poles and overhead equipment for the Corporation tramways. See "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Spain.—August 20th. The Municipal Authorities of Aranjuez (province of Madrid) are inviting tenders until the 20th inst. for the concession for the electric lighting of the town. Tenders are to be sent to El Secretario del Ayuntamiento de Aranjuez (Madrid), whence particulars may be obtained.

Spain.—August 25th. Tenders are being invited until the 25th inst. by the Spanish Post and Telegraph authorities for the concession for the establishment and working during a period of 25 years, of a telephone exchange in the town of Perona. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Spain.—August 25th. The Spanish Post and Telegraph authorities are inviting tenders until the 25th inst for the establishment of telephonic communication between Gijon (Ovildo province) and Pola de Siero *vid* Granda and La Collada. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Swindon.—August 26th. Rails, permanent way, and paving for Corporation tramways. See "Official Notices" July 31st.

West Ham.—August 21st. Traction switchboard, booster, &c. See "Official Notices" July 31st.

CLOSED.

Eccles.—The T.C. has placed the following contracts :—Messrs. Meldrum Bros., of Timperley, to supply and erect two refuse destructor furnaces, at £1,985; Messrs. Marshall & Sons, Ashton-under-Lyne, erection of destructor buildings, £1,168; Messrs. John Wolstenholme & Son, Radcliffe Bridge, clinkering machinery, £787.

Engine Contracts.—The following contracts have recently been placed with Messrs. W. H. Allen, Son & Co., Ltd., of Bedford:—One 750-I.H.P. engine and surface-condensing plant for the Fairfield Shipbuilding Co.; one 105-B.H.P. engine for Messrs. Mather & Platt; one 30-B.H.P. engine for Messrs. Parkers; one 3½-B.H.P. engine for the Lahmeyer Electric Co., for the Chelsea Polytechnic; nine 24-B.H.P. engines for the Union Castle Co.; one 133-B.H.P. engine for the British Schuckert Co; three 900-I.H.P. triple-expansion engines and surface-condensing plant for the Cardiff Railway Co.; two 10-B.H.P. engines for the Adelaide Steamship Co.

Heston and Isleworth.—The following tenders were submitted for the supply of electric lighting plant to the U.D.C. Messrs. J. and J. S. Enright are the consulting engineers:—

Section 2.—Engines, Dynamos, Switchboard, &c.

Bruce Peebles & Co.	£5,359	Siemens Bros.	£6,048
Davey, Paxman & Co. (accepted)	5,550	Reavell & Co.	6,075
General Electric Co.	5,571	Johnson & Phillips	6,140
Witting, Eborall & Co.	5,645	Frank Suter & Co.	6,177
Lahmeyer Electrical Co.	5,649	Dick, Kerr & Co.	6,186
Crompton & Co.	5,729	Brush Elec. Eng. Co.	6,199
International Elec. Eng. Co.	5,777	Elec. Construction Co.	6,252
Mather & Platt, Ltd.	5,991	R. Blackwell & Co.	6,301
British Westinghouse Co.	6,020	Thomas Parker, Ltd.	6,337

Section 4.—Cables.

Western Electric Co.	£9,555	Callender's Cable Co.	£11,187
W. T. Henley & Co. (accepted)	9,852	Anchor Cable Co.	11,412
British Ins. Wire Co.	10,356	St. Helens Cable Co.	11 759
W. T. Glover & Co.	10,924	Johnson & Phillips	12,954
Frank Suter & Co.	11,169	Siemens Bros. & Co.	13,856

Section 5.—Arc Lamps and Standards.

Johnson & Phillips	£718	Oliver & Co.	£893
Brockie-Pell Co.	802	Electrical Co.	904
Crompton & Co.	811	Gilbert Arc Lamp Co.	926
Improved Elec. Glow Lamp Co.	813	Frank Suter & Co.	1,018
British Westinghouse Co.	821	Drake & Gorham	1,402
W. T. Henley & Co.	854		

Leigh.—The Tramways and Electricity Committee of the T.C. has accepted the following tenders:—Messrs. Babcock and Wilcox, Ltd., for the supply of a water-tube boiler with superheater, for the sum of £840; Messrs. P. Storey & Son, Ltd., surface condenser, air and circulating pumps, &c., £690, oil separator, £75 10s., feed pump, £90; and the Klein Engineering Co., Ltd., cooling tower, £463. The electrical engineer has been instructed to purchase the steam valves required in connection with the extensions to the electricity works from Messrs. J. Hopkinson and Co., of Huddersfield.

North Wales.—The North Wales Power and Traction Co. has placed contracts with Messrs. Bruce Peebles & Co., Ltd., for six 1,000-kw. three-phase generating sets, 6,000 volts, direct-coupled to Pelton turbines; the power house and complete equipment thereof, and all accessories; the electrification and equipment of the Beddegelert and Portmadoc Railway, rolling-stock and electrical locomotives, for the sum of £145,000; also for 6,000-kw. transformers and overhead line equipment, £35,000. The whole of the plant will be of the firm's own manufacture, and will be built at Edinburgh.

Penang.—The contractors for the arc lighting of Penang (Messrs. Crompton & Co.) have accepted the tender of Messrs. Rowland Carr & Co, 6 & 8, Lime Street Square, London, E.C., for the supply of the whole of the arc lamp pillars and brackets in connection with their contract.

Portsmouth.—The Telephone Committee has recommended the acceptance of the tender of Messrs. Walter Macfarlane & Co.:—950 cast-iron conduits, 9 ft. 3 in. long overall, by 3 in. bore, as supplied to Glasgow Corporation telephone department, net, delivered at Portsmouth, 5s. 6d. each. The tender of the Ericsson Bell Telephone Co. was accepted as under:—250 wall telephones, at 47s 4d. each; 50 table telephones at 49s. 8d. each, net, delivered at Portsmouth, as required.

FORTHCOMING EVENTS.

Monday, August 17th.—At 11 a.m. Town Hall, Sheffield. Opening of the summer meeting of the Junior Institution of Engineers.

LOCAL AUDIT.

By A LEGAL CONTRIBUTOR.

"A little done well is better than a great deal done badly," is a maxim which has more than age to recommend it. It applies with some force to the admirable report recently issued by the Joint Committee on Municipal Trading.

In giving municipal accounts the most important place, the Committee has taken a wise course. The burden of the report is to establish open and fair dealing between those who are responsible for municipal enterprise, and the ratepayers with whose money great schemes are promulgated. Too often has it occurred in the past that the financial rottenness of an electric lighting or tramway scheme has not been properly exposed, owing to the fact that a large sum, which purports to be profit, has been written off against the rates. In the result, local debt has been increased without stint; the local authorities have taken labours upon themselves which can only be performed to the neglect of more important, but less showy, public duties. If the recommendations of the Joint Committee are adopted, the ratepayers and the public will at least have an opportunity of studying the facts in their true light.

With regard to the appointment of auditors, it is clear from the evidence put before the Committee that affairs are in a lamentable state. It appears that the accounts of Municipal Corporations are audited by district auditors, "who, as a rule, are not accountants, and are not, in the opinion of the Committee, properly qualified to discharge the duties which should devolve upon them."

Even if uniformity in the keeping of accounts be not immediately introduced, uniformity in the appointment of auditors might automatically produce the desired effect. Under existing law, accounts must be kept by all undertakers for the supply of electric light, whether they are local authorities, companies, or individuals. The Board of Trade are authorised to prescribe, and have prescribed the form of such accounts, and they must be published in such manner as may be from time to time prescribed in that behalf by the Board of Trade. Copies of the accounts must be sold at a price not exceeding 1s., under penalty, upon default, not exceeding 40s. So far, therefore, as the supply of electric light is concerned, the ratepayer has some opportunity of investigating the methods of the local authority; but the audit of the accounts, which takes place, of course, before the accounts can reach the public, is carried out on the principles laid down in Sections 246 and 247 of the Public Health Act, 1875. We have already referred to the opinion of the Committee as to the efficiency of such audits.

The Committee have not been content to merely suggest an alteration in the method of appointing the auditor. They recommend that his duties and powers should be materially enlarged. Thus, by Sec. 18 of the report, it is suggested that "auditors should be required to express an opinion upon the necessity of reserve funds, of amounts set aside to meet depreciation and obsolescence of plant, in addition to the statutory sinking funds, and of the adequacy of such amounts."

If auditors take over these duties, what has hitherto been ignored by municipal traders as the criticism of "the capitalists" will then be the criticism of a public official. It has often been shown that many undertakings, which purport to show a profit, would really show a loss if looked at from the point of view of an impartial auditor.

There is another matter to which a careful auditor might direct his attention. We refer to extravagance under the head of wages. The increasing number and scope of municipal undertakings tends to place the managers more and more under the influence of the employés. If brought home to the ordinary ratepayer, this point might weigh with him in deciding where to place his vote at the poll.

The auditor is not to keep his criticism locked within his own breast. He is to forward his report to the Local Government Board, and if the suggestions he makes are not carried out, he is to inform that Board privately of the fact. So sanguine are the Committee as to the effect of a thorough audit, that they think powers of surcharge and disallowance could be altogether dispensed with in the case of the major local authorities.

If only a few of the recommendations of the Committee are adopted by the Government, the gain will be great indeed. Already signs are not wanting to show that the public is losing faith in the stability of security for local loans; if the public are still further enlightened by the judicial reports of independent auditors, it may well be that ratepayers will rise *en masse*, and place their veto upon further extravagance. No longer will the schemes of the labour candidates on county and district councils be furthered without question; no longer will the opinions of the Ratepayers' Committee be treated with silent contempt.

If all the work of this Committee (which, it is hoped, will be reappointed in a future session of Parliament) is performed as this section of it has been, one need not fear the result of its deliberation; on the contrary, it is to be hoped that municipal trading in its every aspect may form the subject of criticism and suggested reform.

NOTES.

South African Notes:—

Cape Town.—The Harbour Board requires the services of an assistant electrical engineer at a salary commencing with £300.

The subject down for discussion at the next meeting of the Cape Town Section I.E.E. is "Notes on the Metric System."

Durban.—The revenue from the electric trams for the month of June was £8,000, an increase of £1,000 over the corresponding period last year.

Pietermaritzburg.—Tenders are being invited by the Town Council for work in connection with the electric tramways, including concrete, plate-laying, bonding, &c.

Harrismith (Orange River Colony).—The Town Council has decided to proceed with the scheme of electric lighting as drawn up recently by Mr. Dawbarn, of Messrs. Mordey & Dawbarn, the consulting engineers to the Council, and has cabled instructions to London to call for tenders.

Johannesburg.—The Tramway and Parks Committee recommended the expenditure of £7,500 on the electric lighting of Troyville. This recommendation was opposed by the Finance Committee.

It was decided to extend the contract with the Rand Central Electric Works for the supply of current from the Berea Street transformer station, to December 31st, 1905.

Central South African Railways.—The Johannesburg—Pretoria telephone service cost the C.S.A.R. £4,000. £75,000 is estimated as the expenditure on railway telegraphs during the year commencing July 1st, being £12,000 over last year.

Potchefstroom (Transvaal).—A step has already been taken towards the settlement of the difficulties of the electric lighting schemes mentioned recently. It appears that it was owing to the case being misrepresented at Pretoria that the Government took the drastic action already reported in this column. Since then, however, the directors of the Potchefstroom Consumers E.L. and Power Co. have had an opportunity of conferring with the authorities, and explaining their position, and have obtained permission to carry lines across the streets to supply their customers, who are mostly shareholders in the company. At a public meeting held last week, a full inquiry into the matter was made, and a resolution was passed to recommend the Health Board to come to terms with the company, and obtain a comprehensive scheme for the whole town. The charge proposed is 1s. 4d. per unit, 2d. per unit less than the charge made to the consumers in Troyville, Johannesburg, and when the dividends of the company reach 12½ per cent. a further reduction is promised.

Paarl (Cape Colony).—A Select Committee is now inquiring into the objects and prospects of a syndicate which proposes the development of Paarl, one of the prettiest villages in the Cape. Paarl is a typical Dutch village, situated among the beautiful scenery of the Drakenstein Mountains, and has a healthy bracing climate, an ideal health resort. It is, however, difficult to get there at present, there being neither railroad nor good driving roads, and the syndicate is seeking powers to build an electric tramway to the village and points of interest from the railway station. Water-power from the mountain streams is the proposed prime motor, which already supplies power for the generation of electricity for the Nantes Flour Mill, which is the site of the syndicate's power station.

Cradock (O.R.C.).—The municipality is calling for tenders for an installation of electric light for the streets and public buildings, and is prepared to grant a concession of 20 years' duration to the successful contractor.

Tramcar Accident.—A serious accident took place at Ramsgate on Wednesday evening. A heavy car was descending the steep incline into the town, full of passengers, when it got beyond control, gathered speed, and collided with a car which was ascending the hill at a point where the tracks interlace. Twelve persons were badly hurt, and seven others injured. The fronts of both cars were smashed.

Institution of Mining Engineers.—The fourteenth annual general meeting of the members of this Institution will be held at University College, Nottingham, on September 2nd, and will be followed on the 3rd and 4th by visits to collieries and works in the adjoining district. The following papers of electrical interest will be read or discussed during the proceedings:—

"Description of Glapwell Colliery, including the Testing of the Three-Phase Hauling and Pumping Plants and Waddle and Capell Fans," by Mr. Maurice Deacon.

"Coal Mining in Warwickshire, with Special Reference to the Work of Stanley Coal Heading Machines in the Rapid Development and Working of Nuneaton Colliery," by Mr. F. C. Swallow.

"The Brandt Drill and Rapid Tunnelling," by Mr. Francis Fox.

"Alternating Currents and their Possible Application to Mining Operations," Part II., by Mr. Sydney F. Walker.

"Some of the Applications of Electricity to Mining," by Mr. Roslyn Holiday.

"Electric Coal Cutting," by Mr. W. Walker.

"The Dynamics of the Winding Engine," by Mr. S. L. Thacker.

Rubber Frauds.—In the Crown Court at the Liverpool Assizes on 7th inst., before Mr. Justice Bigham, Solomon Kramrisch, 39, merchant, surrendered to his bail to answer charges of having fraudulently converted to his own use certain valuable securities. The specific count of the indictment investigated was that at Liverpool, on November 6th, 1902, being entrusted with two bills of exchange for £5,000 and £924 respectively, in order that he might use the proceeds in discharge of certain liabilities for rubber, he fraudulently converted them to his own use; and also that on November 7th, being entrusted with two delivery orders for 149 packages of rubber, he fraudulently converted the same to his own use. Mr. Pickford, K.C., and Dr. Thomas were counsel for the Crown, and accused, who pleaded not guilty, was defended by Mr. Horridge, K.C., with whom was Mr. Leslie Scott. The jury returned a verdict of guilty, and sentence of 12 months' hard labour was passed.

Commercial Developments in Lancashire.—The Crawshaw Estate, situate in Farnworth, has been purchased by a syndicate of gentlemen, and it is proposed to erect tube and metal works thereon; also a portion has been taken over by a well-known firm of electric carmakers. Employment at these works will be found for about 2,000 workmen, which, in view of the depressed state of trade in Widnes, will be much welcomed.

Glasgow and West of Scotland Technical College.—The next session of this college begins on September 21st; courses are provided for the diploma in mechanical and electrical engineering, amongst many other departments. Holders of the diploma are eligible for the degree of B.Sc. in Engineering of the University of Glasgow, after attendance for at least one session at the University, and the laboratories are well equipped with modern apparatus. The preliminary examination will commence on September 14th, and names of candidates must be lodged not later than September 11th.

Warning to Manufacturers.—We have received from the Phœnix Dynamo Manufacturing Co., Ltd., Bradford, a letter to the effect that a man is going about "with a tale of an order to place," against whom they desire to warn their fellow manufacturers. The man in question represented that he was the engineer for Messrs. Brooks & Brooks, quarry owners, Clough Fold, near Manchester, and that they were about to put in electric lighting and power plant, of which he appeared to have some technical knowledge, and for which he wanted a price. "On leaving, he stated that he should require some refreshment while in the town waiting for his return train to Todmorden, and this is where his artfulness comes in, for we do not see how he is to be prosecuted except for begging." Inquiries afterwards showed that the man was not in the employ of Messrs. Brooks, but was a "perfect fraud," and had been giving their name in the same connection for some time past. The P.D.M. Co. suggest that if he be identified by other firms he should be detained, with a view to stopping his proceedings.

The description of the man is as follows:—"Age about 65—70, grey, ruddy complexion, grey moustache, blue eyes, height about 5 ft. 6 in., very clean in appearance, except for his clothes, which have seen their best days."

The Paris Disaster.—Referring to the terrible catastrophe described in our "Traction Notes," it is of melancholy interest to note that Mr. George Westinghouse last year addressed a warning on the dangers of electrical railways to the *Railroad Gazette*. "Already," he said, "there have been many serious collisions, with great loss of life, between electric cars, while there have been numerous cases in New York and other places in which cars have been quickly destroyed by fires which have resulted from some derangement of the electrical apparatus or circuits, and, in some instances, so quickly that the passengers have scarcely had time to escape to the street. The destruction by fire of a car or train upon a street or upon a level is one thing, but such an occurrence upon an elevated railway or in a tunnel can have consequences the contemplation of which should lead to wise regulations governing the construction and use of electrically-propelled trains, and thereby insure to the public the rapid development of electric traction."

A similar warning is found in Colonel Yorke's evidence before the London Traffic Commission:—"I think there are certain dangers which exist in tubes, and which will always, more or less, exist in tube railways, where very large currents of electricity at very high voltage are in close proximity to the trains, so that if any accident happens to the trains there is a risk of fire; and the facilities generally for the escape of passengers in the existing tubes are very slight indeed, even if no fire broke out. Supposing a minor collision occurred, the risk of a panic in a heavily-crowded train, as some of the trains are, seems to me to be a very grave one indeed." And again, in 1901, he said:—"A very small fire, which in the open air would be of no importance, but which might create a volume of smoke, would in a tube be of the most dangerous character."

The Electric Carbon Industry.—The following letter recently appeared in the *Financial News*:—

"Sir,—Mr. Byngswanger (the chairman of the General Electric Co.) is reported, in the *Manchester Guardian* of the 25th inst., to have said that their electric carbon works were the only ones in England, and that their loss in working of £20,000 was largely due to the carbon works. I wish to draw your attention to the fact that the English Electric Carbon Co., Ltd., Brymbo, which was started in 1893, long before Mr. Byngswanger ever thought of making electric carbons, has been in operation ever since, and has supplied carbons on an extensive scale to most of the leading consumers in the United Kingdom.

"No doubt Mr. Byngswanger is in a position to appreciate the Continental competition in carbons, and it is to be hoped that the talked-of change in the British fiscal policy will be accomplished, and give relief in a quarter where it is much needed.—Yours truly,

"J. S. Wynne, Secretary.

"Electric Carbon Works, Brymbo,
"near Wrexham, *July 30th*."

National Telephone Co., Ltd., v. Mayor, Aldermen and Citizens of Kingston-upon-Hull.—In the Chancery Division of the High Court of Justice on Wednesday, Mr. Justice Buckley had before him a motion to vary the minutes of the order as drawn up by the Registrar in this case.

Mr. Astbury, K.C., for the plaintiffs, in support of the motion, said that it was with regard to the question of the cost of the action, and the question was whether, under the Public Authorities' Protection Act of 1893, the plaintiffs had to pay the costs as between solicitor and client. His Lordship would remember that the short point in the action was whether the company were, under the latest Telephone Act, entitled to a renewal of their license from the Postmaster-General, or whether a notice given by the Corporation determining an agreement of 1899, by which the company maintained a telephone system in Hull, deprived them of that right. By the agreement of 1899, the Telephone Co. had power to lay underground works in Hull, and there was a provision in the agreement that, by a certain notice given by the Corporation, they could determine the agreement. The Corporation gave the notice, and when the new Act of Parliament came in force which provided for licenses subject to existing rights, the question arose of whether the Hull Corporation could have their own system and deprive the Telephone Co. of the expenditure they had incurred in laying down and maintaining their system. The Court had held against the plaintiffs, and they were ordered to pay the costs. His contention on the present motion was that the question turned upon the agreement between the parties, the defendants having given notice under the terms of the agreement and not under any Act or in the exercise of any public authority. He submitted, therefore, that the question was not one that had anything to do with the Public Authorities' Protection Act, and that, therefore, the defendants were only entitled to party and party costs. The right that the plaintiffs asserted was a right under the contract and not under any statute.

Mr. Danckwerts, K.C., for the Corporation, submitted that the question turned upon the statute, that in defending the action the Corporation were defending a public right, and were, therefore, entitled to the protection of the Act.

Mr. Justice Buckley said that in his opinion the Public Authorities' Protection Act did not apply. In one sense, any act done by a Corporation must be done for the protection of the public, but the Act did not mean that. There was no duty on the part of the Corporation to determine the contract with the plaintiffs. Nor were they in so determining it acting as a public authority. They thought it right to determine it under a clause of revocation, which they had reserved to themselves, and under the circumstances they were not entitled to the benefit of the Act. He, therefore, struck out of the minutes of the order, the words "as between solicitor and client," and ordered the defendants to pay the costs of the motion.

Personal.—Mr. H. F. Hunt, chief electrician to Veritys, Ltd., having been appointed by the Admiralty to the post of electrician at Pembroke Dockyard, an interesting presentation of a barometer was made to him at Messrs. Veritys' Aston works, on the 1st inst., by the staff. Mr. Ebbutt, on behalf of the directors, referred to the high appreciation in which all in the company held Mr. Hunt, and their great regret at his leaving. Mr. F. O. Hunt, for some time associated with Messrs. the General Electric Co., and until recently at their Witton works, has been appointed to succeed Mr. H. F. Hunt.

Mr. Robert H. Horsfield, chief assistant in the Tramways Department of the Bradford City Corporation, has been appointed tramways manager to the Walsall Corporation, at a salary of £200 per annum, rising by £25 per annum to £250.

On the occasion of the Jubilee celebrations of Heidelberg University, amongst other distinctions conferred upon British savants, we note that Prof. Sir W. Ramsay, F.R.S., Dr. R. T. Glazebrook, F.R.S., and Sir W. Huggins, P.R.S., were the recipients of honorary degrees.

Appointments Vacant.—Lagos Government Railway—electrician and lineman; salary £300 rising to £350. Londonderry—assistant electrical engineer, salary £130. Hull Municipal Technical School—lecturer in electrical engineering, salary £150. Woolwich—charge engineer, salary 104 guineas. Hull—chief assistant electrical engineer, salary £200. Bexley—charge engineer (£100) and junior charge engineer. Bradford—city electrical engineer; salary £600. Islington—assistant engineer and works manager; salary £200, rising to £250. See "Official Notices" to-day.

Motor Speed Regulation.—Continuous and Alternating.—Although much has been written and said on this subject lately, the question of speed control is still very much to the fore, not only in our country, but also in the States. The *Journal of the Association of Engineering Societies* records a discussion which recently took place before the Engineers' Club of St. Louis. The question to-day is not as to the relative economy of electrical and mechanical transmission, but as to the increased output which may be obtained by the individually-driven tool. For special classes of work it is said that the output may be doubled and even trebled, but in this country, at any rate, for ordinary machine tools as used, say, in a dynamo shop, the extra output as compared with mechanical driving may be put at 25 per cent. to 30 per cent. Motors are now made which will work with a 3 to 1 speed variation, 900 to 300 r.p.m., obtained by shunt regulation only, and therefore at a maximum efficiency. The motor is, of course, large for its work, but the controlling arrangements are reduced to their simplest form, and there is an entire absence of that complication which is inseparable from the use of multi-voltage and allied systems. Whilst hitherto no great progress has been made towards a solution of the variable speed problem in connection with alternating motors, the matter is still receiving special attention. In the works of Ganz & Co. two and three-phase motors are used and are each connected with either of two generators working at 50 and 25 cycles respectively. In the Oerlikon Works, motors with short circuited armatures are provided with two sets of field windings, one having double the number of poles of the other. A combination of this device with the double frequency system could be made to give a wide range, and whilst this would not be such a simple arrangement as the continuous current shunt rheostat method, such a system would compare favourably with the multi voltage methods. It has the advantage that for small motors no starting switches are necessary, the motors being switched direct on to the mains. The advantages, both direct and indirect, of individual control, are now becoming generally recognised, advantages which far outweigh such considerations as the comparative economy and efficiency of electrical and mechanical driving.

THE CENTRAL STATION ENGINEER.

The annual dinner in connection with the Croydon Electricity Works was held at the Café Royal on Friday, the 31st ult., and the opportunity was taken to present Mr. Scott, the chief engineer, with a case of cutlery and plate on the occasion of his approaching marriage. The presentation was made by the chairman of the Electricity and Lighting Committee, Mr. Alderman Miller, on behalf of the staff and employés. A lengthy programme of vocal and instrumental music was carried on to a late hour by the various members of the staff and friends.

At the last meeting of the Electricity and Lighting Committee Mr. Scott was presented by Mr. Alderman Miller, on behalf of the Committee, with a handsome marble and bronze clock.

Mr. J. H. Woods, the mains superintendent at the Plymouth Corporation Electricity Works, is shortly leaving England to take up a similar position at the Durban Electricity Works, South Africa. On Thursday last week, in the presence of the staff, Mr. S. T. Allen, assistant borough electrical engineer, bore high testimony to the manner in which Mr. Woods had carried out the duties entrusted to him, and wished him on behalf of the staff every success in his new appointment, while handing him a gold albert and medallion. Mr. G. H. Woods and Mr. W. J. Edmonds also spoke highly of Mr. J. H. Woods, who suitably replied and thanked the staff for their substantial expression of goodwill and esteem.

Mr. Chas. J. Turner, one of the mains assistants from the Electricity Department of the Metropolitan Borough of Islington, has been appointed chief assistant at the Hoylake Electricity Works.

The salary of Mr. Teasdale, of the Cardiff Electric Lighting Department, has been increased from £200 to £250 per annum.

The Wigan T.C. has decided to increase the salary of Mr. James Slevin, the electrical engineer and tramways manager, from £250 to £300 per annum, and that of Mr. Dewse, accountant in the electrical department, from £150 to £170 per annum.

Mr. J. M. Keenan, chief assistant electrical engineer at Taunton, has been appointed assistant electrical engineer at Torquay, at a salary of £156 per annum.

The Hull T.C. has appointed Mr. Wilkinson to be borough electrical engineer, and Mr. Bell to be tramways engineer and manager. Both gentlemen were on Mr. Barnard's staff prior to his resignation.

ELECTRICITY SUPPLY ACCOUNTS.

Wimbledon Municipal Electricity Supply.

We give herewith the returns of the electricity undertaking of the Wimbledon U.D.C. for the past 12 months. Financially the Department has every reason for congratulating itself, having considerably increased its net profit over last year, and with the prospect of an enlarged area and correspondingly increased output, there is every possibility of the excellent record of the past four years being continued in the future.

The Department is, we think, unique in the matter of street lighting, having, at the present, over 1,100 street lighting posts, each fitted with two incandescent lamps, and a special system of street lighting feeders. The record of the past four years' work is as follows:—

Year.	Units sold.	Working expenses.	Total expenses.	Total revenue.	Profit or loss.
1900	154,450	£2,322	£3,712	2,671	−£1,041
1901	644,421	6,338	9,374	9,508	134
1902	785,815	7,875	11,881	13,239	1,358
1903	1,011,998	8,365	13,944	15,472	2,028

The prices charged are:—For both private and public lighting, on the maximum demand system, 7d. per B.T.U. for the first hour, and 2d. afterwards. Power and heating are charged on a flat rate of 2d. per unit. Mr. H. Tomlinson-Lee is the borough electrical engineer.

General Statement.

For year ending March 31st—	1902.	1903.	Inc.
Total capital expended	£85,964	£100,202	£14,238
Number of units supplied	785,815	1,011,998	226,183
Equivalent number of 8-c.p. lamps connected	37,604	53,967	16,363
Number of public lamps	1,025	1,091	66
" " " equivalent in 8-c.p. lamps	4,100	4,486	386
Maximum load in kw.	510	603	93
Revenue Account. Gross revenue ...	£13,239	£15,472	£2,233
" expenditure ...	£7,875	£8,365	£490
" profit	£5,364	£7,107	£2,743
Average price per unit obtained for street lighting	—	2·54d.	

Revenue Statement.

For year ending March 31st, 1903—	Gross.	Per unit.
By sale of energy	£14,999	3·56d.
Rental of meters, &c.	398	·09d.
Sundries	75	·02d.
Gross revenue	£15,472	3·67d.

Working Expenses.

	Gross.	Per unit.
Coal and other fuel	£3,877	·92d.
Oil, waste, water and engine room stores ...	449	·10d.
Salaries and wages incurred in generation and distribution	912	·29d.
Repairs and maintenance of buildings, machinery and plant	400	·09d.
Works and distribution costs	£5,648	1·40d.
Public lamps, attendance, repairs, or renewals	£876	·20d.
Rent, rates and taxes	440	·11d.
Management expenses, salaries of engineers and clerical staff	986	·23d.
General establishment charges, printing, stationery, law, insurance, &c.	415	·09d.
Total works costs ...	£8,365	2·03d.

Profit Statement.

Interest on loans	£2,613
Sinking fund	2,447
Expenses of obtaining Merton Prov. order ...	19
Nett profit on year's working	2,028
Gross profit	£7,107

During the year the department has earned a gross profit of £7,107, and after providing for financial charges and special expenses incurred in connection with the Merton provisional order, there remains the sum of £2,028, which was applied—£500 to the reserve fund, and £1,528 in relief of the local rates.

Maidstone Municipal Electrical Supply.

We give herewith an analysis of the Maidstone electrical department's first 15 months' working under Mr. E. E. Hoadley, the electrical engineer. This undertaking gives promise of rapid development in the near future, with a tramway scheme on the way, and a growing motor and public lighting load.

The works costs are somewhat abnormal, owing to the inclusion in management expenses of all the preliminary expenses since the granting of the prov. order some eight years ago, and, no doubt, they will show a considerable improvement in the next year's working.

The prices charged are:—Private supply, 7d. and 2d. on the maximum demand system, or as an alternative to shops, a flat rate of 5d. per unit, and to clubs, dwelling houses and public houses, 4d.; power supply, 2d. to 1d. per unit.

General Statement.

First 15 months' working, ending .. March 31st, 1903.	
Total capital expended	£45,241
No. of units sold. Private supply...	206 143
Public "	99,545
Total	305,688
Number of 8-c.p. lamps connected	19 256
Horse-power of motors connected	about 250
Maximum load in kw.	223
Load factor	12·2%
Revenue account. Gross revenue	£5,032
" expenditure	£3 559
" profit	£1,473
Average price obtained per unit for street lighting	1·91d.

Revenue Statement.

	Gross.	Per unit.
Sale of energy	£4,662	3·67d.
Meter rents, &c.	370	·28d.
	£5,032	3·95d.

Works Costs.

	Gross.	Per unit.
Coal and other fuel, including cartage...	£1,196 3 7	·87d.
Oil, waste water and engine room stores	129 12 3	·09 l.
Wages incurred in generation and distribution	710 9 7	·52d.
Repairs and maintenance of buildings, machinery, mains, &c.	53 8 4	·04d.
Works and distribution costs	£2,089 13 9	1·52d.
Rents, rates and taxes	246 13 5	·18d.
Management expenses, salaries, engineers' department, general establishment charges, stationery, printing, &c.	802 3 11	·59d.
Total works costs	£3,138 11 1	2·29d.

Profit Statement.

Interest on loans	£2,188
Sinking fund...	2,447
Nett deficit	—3,162
	£1,473

Grimsby Municipal Electric Supply.

The returns of the Grimsby electrical department for the past year show that the output has considerably more than doubled, largely owing to the great increase in traction units. The revenue has also improved in greater ratio than the financial charges, and, aided by improved works costs, the net deficit on the year has been reduced to 2·2 per cent. on the capital as compared with 4·1 per cent. in the preceding and first year of operation.

The prices charged are:—For private lighting, 4½d. per B.T.U.; power 2½d. to 1½d. per unit.

Mr. W. A. Vignoles is the borough electrical engineer.

General Statement.

For year ending March 31st—	1902.	1903.	Increase.
Total capital expended	£57,874	£71,253	£13,379
Number of units sold—			
Traction	90,492	372,114	281,622
Public lighting	88,012	95,702	7,690
Private lighting	113,590	185 622	72,032
Total units sold	292,094	653,438	361,344
Equivalent number of 8-c p. lamps connected	13,061	21,334	8,273
Horse-power of motors connected	14	45	31
Maximum load in kilowatts ...	392	508	116
Revenue account—			
Gross revenue	£7,387		
Gross expenditure	£4,089		
Gross profit	£3,298		
Average price per unit obtained from public lighting	3·84d.		

Revenue Statement.

For year ending March 31st, 1903.	Gross.	Per unit.
Sale of energy	£7,209	2·64d.
Rental of meters and profit on sale of lamps, &c.	118	·04d.
Sundries	60	·02d.
Gross revenue ...	£7,387	2·70d.

Cost of Production.

	Gross.	Per unit.
Coal and other fuel	£1,554	·57d.
Oil, waste, water and engine room stores ...	112	·04d.
Salaries and wages incurred in generation and distribution	752	·28d.
Repairs and maintenance of buildings and machinery	385	·10d.
Total works and distribution cost ...	£2,703	·99d.
Attendance and repair of public lamps... ...	275	·10d.
Rent, rates and taxes	312	·12d.
Management expenses, salaries of engineers' department and clerical staff	456	·16d.
General establishment charges, printing, stationery, insurance, &c.	343	·10d.
Total works costs ...	£4,089	1·47d.

Profit Statement.

Interest on loans	£2,873
Sinking fund...	1,826
Provision for bad debts	30
Credit balance from last year	—10
Nett deficit	—1,421
Gross profit	£3,298

During the year extensions of plant have brought about increased financial charges, and in meeting these and providing for bad debts a deficiency of £1,421 arises—which is, however, a great improvement on the previous year.

CITY NOTES.

Metropolitan District Railway Co.

The half-yearly meeting of the proprietors of this company was held on 6th inst., at the Westminster Palace Hotel, Mr. R. W. Perks, M.P., presiding.

The Chairman, in proposing the adoption of the report, said there was a slight falling off in the receipts, notwithstanding that they had carried over 3 million more passengers. The work of electrification upon the railway was progressing very rapidly. He had a report from Mr. Chapman, their electrical engineer, who was engaged on the work, stating that there were at present about 1,000 men employed on that important work. He had 600 men engaged continuously in laying the conductor rails, carrying the ducts under the platforms, and doing the general construction work, which had already been completed so far as the Ealing and Harrow line was concerned. He doubted whether the majority of those who travelled on the railway were aware that there was such an enormous army of workmen constantly at work in the transformation of the railway from steam to electricity. The work had to be done under very extraordinary conditions, and mainly at night, which largely retarded the progress which would otherwise be made. The generating station at Lot's Road, Chelsea, was already carried up to a great height, and about 70 to 75 tons of steel was being erected every day when it was fine. One of the chimneys was already 75 ft. above the basement level. About four-fifths of the ducts from Chelsea to Earl's Court—in all about 40 miles—had already been fixed. As the proprietors were aware, the payment for the electrification work was to be made very largely in the unprotected stocks of the company. The electrical company had already taken half a million's worth of ordinary stock at 25, which was the price they originally agreed to place that lot with them, and they would have to take the next lot—£485,000—at 35. They would then be entitled to the debentures in respect to those two stocks, viz., £166,000 4 per cent. debentures, which they would take at par; and £180,000, or thereabouts, of further debentures, which they would take at the same price. Under their Bill of this session they had got power from Parliament to issue £900,000 additional capital, and they had agreed to issue £600,000 of that to the electrical company as a second preference stock at the price of 65. He gave a pledge two years' ago to the proprietors that nothing should be done to jeopardise the condition of the guaranteed or preference proprietors, and it showed the faith which the Underground Electric Co. had in the ultimate success of the District Co., that they had consented to accept so large a portion of the money that was to be paid them for the electrical equipment of the railway in ordinary and second preference stocks. The Ealing and Harrow line was being run electrically with a service of four electric trains, and it already showed as satisfactory returns as their original Ealing and Fulham line showed when it had been established a similar time. At present passengers had to get out of the electric trains at Mill Hill Park and change into the steam trains. On the Whitechapel and Bow line they had done an enormous business both in the morning and evening, but at present they could not get a sufficient number of trains through to the Tilbury line to give them an adequate return upon the capital employed in the Whitechapel and Bow Railway. The Tilbury Co. were widening their line down to Barking, and as soon as that was completed they would be able to give a five minutes' electrical service to East Ham. Under the new system of electrification they would be able to enormously increase the number of trains run. He was told that on the American electric railways in the vicinity of New York there were run with perfect safety as many as 40 to 50 trains in the hour, and he did not see any reason whatever, if the Board of Trade sanctioned their automatic electric signalling apparatus, why they should not do the same. Their electrical engineer proposed to run five minutes' services from Wimbledon, Richmond, Hounslow, Ealing and Harrow. The Metropolitan Co. were urging them to increase the number of trains on the inner circle. At present they were running six per hour, and they might increase them to 10. But the tendency now was for the circular traffic to decrease, and they would be wisely advised in regarding the railway more as an east to west line than as a circular route. The rolling stock that had been ordered would provide a carrying capacity of from 100 to 120 millions of passengers per annum. The directors were giving very careful attention to the subject of fares, and it might be necessary for them to ask Parliament to allow them to institute over the whole railway a 2d. fare for rich and poor alike, irrespective of the hour of booking. England was the only country, where railways were compelled to carry workmen at special fares. On their railway they carried between 45 and 50 million passengers per year, and it must be borne in mind that the 10 or 11 million workmen whom they carried at abnormally low rates were practically being carried at the expense of the other 80 per cent. of the travellers. A 2d. fare for anybody at any time was a democratic sort of proposition which ought to commend itself to Parliament and to the London County Council.

Mr. L. H. Isaacs seconded the motion, and the report was adopted.

Waterloo and City Railway Co.

The half-yearly meeting of the shareholders of this company was held on 6th inst. at Waterloo Station, Lieut.-Colonel the Hon. H. W. Campbell presiding.

The Chairman, in proposing the adoption of the report, said there was nothing which called for much comment that had occurred during the half-year. The traffic had been greater than in the corresponding half-year of 1902, although less than in the intermediate half-year ending last December. They carried 41,739 more passengers than in the corresponding half-year, and the season ticket-holders had increased by 47. The receipts from passengers, after deducting Government duty, was more by £222. On the other side, the working expenses had increased by £307, and were at the rate of 46 per cent., as against 44·84 per cent. in the June half of last year. General charges were less by £47, and they carried to the net revenue account a balance of £9,088. Upon looking at that account they saw there was enough to pay a dividend at 3½ per cent. on the ordinary stock but not quite enough to pay 3¾; but they had in reserve a sum of £1,800, which was a profit made on the sale of Consols (parliamentary deposit), and they thought it advisable to take £300 of that and place it to the credit of the net revenue account. This, after providing for prior charges, left £8,945 available for dividends. A dividend at 3¾ per cent. per annum absorbed £8,775, and left £170 to be carried forward. This was the dividend which they now proposed, and he hoped they would consider it satisfactory. Having once paid 3¾ they wanted to do it again, or better, if possible. The line was doing well, and the trains ran with great regularity, there being very few failures. They would like to see the traffic increase, and, perhaps, it might, but at present the working company ran as many trains as they could. If the storage accommodation for trains was increased, they might be able to run more trains, and they would, perhaps, see this carried out in the near future. Their traffic depended largely on the weather, a wet or dull day bringing more people on to the line than in fine weather. In that respect it was the very opposite of the overhead railways.

Sir Algernon West seconded the motion and the report was adopted.

The Lancashire Electric Power Co.

Mr. F. E. Gripper, chairman of the Lancashire Electric Power Co., at the ordinary meeting of the shareholders, held in London on the 8th inst., said that the company having now raised the necessary capital for the equipment of their first station, which would be situated near Radcliffe, a contract had been entered into with the Lancashire Power Construction Co., Ltd., to carry out the whole of the work, for a plant with a total generating capacity of 6,000 kw., with sub-stations and 60 miles of mains and cables, and as the local authorities with whom they had been negotiating were anxious for a supply of electricity in bulk, every effort was being made to expedite the work of construction. By the end of 1904 or early in 1905, they expected to be in a position to afford such a supply.

Liverpool Overhead Railway Co.

The half-yearly meeting of the Liverpool Overhead Railway Co. was held on Tuesday, 11th inst, at the Law Association Rooms, Liverpool, Sir Wm. Forwood, chairman of the company, presiding. The report showed that the number of passengers carried during the half-year compared with the corresponding half-year of 1902 is as follows:—First class (1902) 656,756, (1903) 759,180; second class (including tramways, 1902) 2,966,690, (1903) 3,334,703; workmen (special return tickets, 1902) 1,402,976; (1903) 1,420,116; total, 1902, 5,026,422; 1903, 5,514,089. Receipts from passenger traffic amount to £40,858 13s.; miscellaneous receipts and interest, £805 13s.—£41,664 6s; less working expenses, £32,005 8s. 9d.; deduct interest on mortgage debentures, £3,800; add balance brought forward December 31st, 1902, £4,013 8s. 7d.; less available for dividend, £9,872 5s. 10d.

The Chairman, in moving the adoption of the report, said it was extremely gratifying to come before the shareholders with such an encouraging report. It was perhaps not quite as good as they would like, but it indicated that they had turned the corner, and might reasonably look forward to further improvements. It strongly showed that they were justified in expending capital upon accelerating the service. Besides bearing satisfactory results to the shareholders, it had been greatly appreciated by the public. The traffic for the past half-year numbered 5,514,089 persons as compared with 5,026,422 in the corresponding period of last year, thus showing an improvement, in round figures, of half a million. They had carried 759,180 first-class passengers as against 656,756, and the receipts were £41 549 as compared with £37,833, an increase of £3,696. But in order to earn that increase they had had to spend more money in coal, stores, &c., because an accelerated service meant using greater power. The increase in expenditure amounted to £2,716, but in that sum there was included £500 as a sinking fund for the company's tramways. There was a net increase in traffic of £1 559, which was 9 per cent. of the new capital invested for the purpose of acceleration. They had now placed the company in a much stronger position, and they had certainly conferred a great boon upon the trade of the port. Assuming that each passenger who spent 10 minutes on the railway earned 5s. per day, he found that the saving in time to the public amounted to £20,000 per annum. The amounts they had regularly put aside for renewals and sinking fund, now reached the substantial figure of £26,200. The revenue account for the half year was, from passenger

traffic, £40,858, and miscellaneous receipts, £681; a total of £41,549; and the working expenses were £32,003. Out of the surplus the directors proposed to pay a dividend of 5 per cent. on the preference shares, and 1¼ per cent. on the ordinary shares, leaving £3,747 to be carried forward. During the half-year two Bills in which they were greatly interested had passed through Parliament, and had received the Royal assent. The first enabled the Cheshire Lines Co. to make a line from St. Michael's to their railway at Herculaneum Dock Station. That would form a link with the Cheshire Lines Co., and through them with the outer belt of Liverpool. So far they had not made any definite arrangement, but willingness had been expressed on both sides to complete one. The other Bill was the Seaforth and Sefton Junction Railway, which would effect a junction between the Overhead Railway at Seaforth, and the Lancashire and Yorkshire Railway at Aintree, and so bring about a connection with the Overhead Railway and Seaforth. It would thus be a most important link in the outside circle round Liverpool. The greatest importance must be attached to these girdle railways. They had already arranged the working of the trains, upon terms to be negotiated, and he trusted that the agreement with the Lancashire and Yorkshire Railway would be completed within the next two or three weeks. They would then join with that system at their Sefton Station, and trains would be run through from Southport right on to the Overhead Railway system, and *vice versâ*. The advantages of that link could not be over estimated. With regard to the structure and equipment of the railway, it was still well maintained, and they hoped shortly to have a five minutes' service running throughout the day. All they now wanted was an increase of earnings, and he hoped that would come with increased traffic. While they gave to shareholders £3,125, they had practically to pay the same amount for rates, and when they considered that the line was constructed more for the good of the port than for the shareholders, he did think that £6,000 a year for rates and taxes was most excessive.

Mr. Harold Brocklebank seconded, and the motion was carried, as was also a proposition for the payment of the dividend mentioned by the chairman.

Mr. Walter Wilson asked if the attention of the engineer had been drawn to the line north of the Alexandra Dock Station, where there was a double curve, which was traversed at such a speed that the oscillation frequently threw passengers out of their seats. He also thought it would be a great convenience if lifts could be introduced at the Pier Head and James Street Stations.

Another Shareholder suggested that steps should be taken to get the rates reduced.

The Chairman, in reply, said the safety of the passengers was always the first consideration. The curve mentioned had quite recently been relaid, and it was absolutely safe. With regard to their rates, representations had been made, and they got a reduction last year. Answering a further question as to whether the Cheshire Lines Co. were likely to electrify part of their system, the chairman said in his opinion it was only a question of time when all great suburban railways would have to be electrified.

The meeting terminated with a vote of thanks to the chairman.

Electric Welding Co.—The annual meeting of the shareholders of this company was held on 7th inst. at the offices, 28, Basinghall Street. We are unable to give a report of the proceedings, as our representative was refused admission, and a request for a copy of the directors' report was also refused.

Kent Electric Power Syndicate.—A meeting of the shareholders of this syndicate was held on 7th inst. at 7, St. Helen's Place, Bishopsgate Street. Our representative was informed that the proceedings were private.

Harrow Electric Light and Power Co.—Mr. G. W. Spencer Hawes, M.I.E.E., of Westminster, has been elected a director of this company.

The London United Tramways (1901), Ltd.—The directors of this company have declared an interim dividend of 8 per cent. per annum on the £10 ordinary shares for the half year ended June 30th last. The dividend warrants will be posted on Friday, the 14th inst.

Dublin and Lucan Electric Railway.—The report of the Dublin and Lucan Electric Railway Co. for the half-year ended June 30th last, to be submitted at the meeting on the 20th inst., states that total receipts for the half-year show an increase of £61. Expenditure shows a net increase of £167, including £137 for rebuilding a boundary wall, and £50 for repairs due to the great storm of February 26th. After providing for debenture interest there is a balance available of £837, out of which it is proposed that a dividend at the rate of 5 per cent. per annum be paid on the preference shares, and that £300 be placed to reserve account, leaving £62 to be carried forward.—*Financial Times.*

Baker Street and Waterloo Railway Co.—The report of the directors shows that the capital expenditure during the half-year ended June 30th last amounted to £143,513. The expenditure during the current six months is estimated at £250,000. The construction of the works has gone forward satisfactorily. A resolution will be proposed at the meeting, to confirm the forfeiture of certain shares upon which arrears of calls have not been paid.

STOCKS AND SHARES.

Wednesday Evening.

Financial unrest in New York is the most prominent feature of the money markets, and the situation contains causes for anxiety that must affect almost every department of the Stock Exchange. While the main issues of the struggle are being fought out by the millionaire railroad merchants of the United States, the echoes of the contest have a disquieting influence upon Consols, and through them upon all the investment departments. The magnates on the other side are being forced to realise big blocks of high-class securities in order to keep their financial positions at all liquid, and since they hold a good deal of sound British stocks, the stir of the strife will, perhaps, penetrate Capel Court still further if the impending catastrophe should fail to be averted.

The Telegraph market, however, is maintaining its recent advances without any difficulty. Even Anglo-American Telegraph stocks did not move upon the publication of the Postmaster-General's Budget, which showed that the Government are willing to act as the agent of the Marconi Co. whenever the latter can satisfactorily establish its claim to be able to supply an efficient service across the Atlantic. At one time, and that not so very long ago, such an announcement would have been greeted with dismay by telegraph stockholders, and probably followed by heavy selling on behalf of small provincial investors. But the time of scares over wireless telegraphy has gone by, for the present at any rate, and the movements this week certainly do not speak of failing confidence. Anglo-American Deferred has fallen ¼, but the other stocks of this group look on with composure at the nervousness in the general markets. Submarine Cables Trust certificates are up still further, notwithstanding the *débâcle* in the Yankee market, the violent movements, of course, bringing welcome grist to the mills of the telegraph companies. A little inquiry for Direct Spanish Preference helped to advance the price 10s. Amongst the Eastern Division, China Debenture has slipped back to its level of a fortnight ago; otherwise there is no change to report. The telephone section may be included in the latter clause, and business in the National issues has passed a decidedly slack week.

The excellent report of the Waterloo and City Railway has made no difference to the price of the stock, and the only changes amongst electrical railway securities are a drooping of 2 per cent. in City and South London and of 1 per cent. in Central London Deferred. This continued fall in the price of City Ordinary is having some effect upon the prior stocks, the three Preferences standing at 130, 128½ and 126½ in the order of their years of issue, all being *ex* dividend. City Debenture at 117½ compares with similar stock of the Central London at 116½, the difference being accounted for by the dates whereon interest is payable. The appalling disaster on the Paris Underground Railway is influencing all the Tube stocks, as well as Metropolitan Consolidated and District Ordinary, the prices of which last are dull at 85½ and 34½ respectively.

Electricity Supply shares are in quiet request, and the list presents the usual firmness with slight improvements. City of London Ordinary shares, so far from being unfavourably influenced by the finding of the House of Lords in regard to the company's claim against the Corporation, are ¼ up, and the market is inclined to regard the decision as possessing no especial financial interest. After all, the progress being made by the chief electrical companies, as exemplified by their advancing dividends, is the best advertisement for such an investment market; although, of course, no substantial advance can be expected while the world of finance continues in its present tremulous condition. Edmundsons' has hardened 5s., upon what is understood to be the success of the issue of their latest "baby;" there is no fall to record in any part of this section.

Thanks to the better feeling now prevalent in the Telegraph market, a rise of a sovereign makes itself noticeable in Telegraph Construction shares. Brush Preference have weakened again, and are back to 1¼ middle, the Second Debenture stock also shedding a couple of points.

That hardening of British Electric Tractions, to which reference was made in our last notes, has produced an improvement of ¼ in the price of the Ordinary, but the Preference are unchanged. A few orders made their appearance the other day in the British Columbia Electric Railway issues, and the Deferred is being dealt in about 73, while the Preferred Ordinary stands at 92½. The report of the Metropolitan Electric Trams Co. was not warmly welcomed, and a seller of the Preference found himself unable to obtain more than 17s. 6d. for the shares. London United Tramways issues keep firm, and this market as a whole is easily upholding its reputation for steadiness.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 5th.	Closing Quotations Aug. 12th.	Business done week ended Aug. 12th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3½	2¼— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50 xd	47 — 50	47	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94 xd	92 — 94	93	92½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8¼— 8¾	8 — 8½	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4¾— 5¼ xd	4¾— 5¼	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	92 — 95	94	93
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	7½	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	6¾— 7½	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101	97 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10½	10 — 10¼	10¼	10⅜
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	128 —133	128 —133	129¼	128½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	89 — 92	89 — 92	91	90
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	106½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½ xd	12 — 12½	12¼	12 7/16
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	106 —109	104 —107 xd	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	98 —101 xd	100 —103	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	..	9 — 9¼ xd	9 — 9¼	9¼	..
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾— 13¼ xd	12¾— 13½	..	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	22½	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	100	99½
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102 xd	100 —102	101½	100⅝
1,966,667	Do. do. Def. Stock	100	..	..	4½%	79 — 81 xd	79 — 81	79½	79
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼ xd	5 — 5¼	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅛	102½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,899	Reuter's	8	5 %	5 %	..	6¾— 7¼	6¾— 7¼	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	113 —118	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5¾— 6	5¾— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5¼	4¾— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅝	12 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	99⅜	..
88,321	West India and Panama Telegraph	10	1%	..	..	⅜— ⅝	⅜— ⅝	½	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6½— 7	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	4 — 5	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	77 — 82	77 — 82	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11¼— 11⅞	11¼— 12	11⅞	11¼
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12¼	11¾— 12¼	12¼	12 1/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	123½—125	122 —125	124½	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7¼	6¾— 7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5¾ xd	5¼— 5¾	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	7/16— 9/16	7/16— 9/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1¼	¾— 1¼	1⅛	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1¼— 1⅝	1 — 1¼	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	87 — 92	85 — 90	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11¼— 12½	11¼— 12¼	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5⅝	5¼— 5½	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	108	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	103 —106	103 —106	104⅝	104¼
494,998	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	102 —105	102 —105	103¼	102⅝
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	105 —108	104 —107	105	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	63 — 65	61 — 63	63	62½
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1¼— 2½	1¼— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 1⅝	1¼— 1½	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19⅝	18⅛	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	8½%	1½%	1½%	5½— 5¾	5¼— 5½	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	32 — 35	33 — 36	35	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—½.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14⅝.
Do. do. Pref. (£10 pd.), 10—10½.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 5th.	Closing Quotations Aug. 12th.	Business done week ended Aug. 12th, 1903. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	£1	..	..	..	5/8 — 7/8	5/8 — 7/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10⅜— 11¼	10⅜— 11¼	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅜	10¼— 10⅜	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅜	9 — 9⅜	9⅜	9⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛— 6	5⅛— 6	5⅞	5⅛
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅛— 5	4⅛— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5⅛%	4 %	4⅛%	5⅞— 6¼	5⅞— 6¼	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	0 %	5 %	5 %	10½— 11	10¾— 11⅛	10⅛	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½— 12½	11¼— 12½	12	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 6⅝	6½— 7	6⅝	6½
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	7½	7
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —109	106 —109	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11½	10½— 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2⅛	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛— 6	5⅜— 6	5⅜	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	100	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅔%	7⅓%	17½— 18½	17⅝— 18½	17⅝	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	14⅓%	15¼— 16¼xd	15½— 16½	15⅝	15⅛
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9 xd	8 — 9 xd	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3½— 3⅝	3½— 3⅝	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3½— 4¼	3⅝— 4¼	4	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5½	5 — 5½	5 1/16	5 1/8
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12½— 13⅛xd	12¾— 13⅛	..	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6⅛	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, August 12th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	150/-	14/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks.. ..	per lb.	2¼d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c ,, Wire, basis..	per lb.	7d.	..
c Copper Tubes (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn) ..	per lb.	9½d.	..
g Copper Bars (best selected ..	per ton	£71	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars ..	per ton	£64	..
e ,, ,, Sheets ..	per ton	£74	..
e ,, ,, Rod ..	per ton	£66	..
e ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/11 to 4/0¾	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/5	6d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 12 6	..
g ,, ,, Sheet	per ton	£11 15	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 10 0	2/6 dec.
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3.9	..
d ,, ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£128 to £129	..
g ,, Foil	per lb.	1/8	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 1/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Tull & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co. *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Aug. 8	1,378	+140	13,069	+ 1,496	10	—
	Birmingham	,, 8	5,576	+363	161,685	+ 7,692	—	—
	Bournemouth	,, 5	1,665	—	—	—	10½	—
	Blackburn	June 26	909	—286	11,668	+ 674	12⅝	+1¼
	Blackpool	Aug. 6	2,066	— 17	19,128	+ 1 335	8½	—
	Blackpool and Fleetwood	,, 8	2,242	+467	7,255	+ 788	7¼	—
	Bolton	,, 9	1,938	+293	36,032	+ 5,108	25	—
	Bradford	,, 10	4,852	+1070	73,098	+19,735	41	+4
	Brighton	,, 9	1,772	+284	31,619	—	6½	—
	Bristol	,, 7	6,613	+330	—	—	28	—
	Burnley	,, 8	902	+198	—	—	7½	—
British Elec. Trac. Co.	Barnsley District ..	July 31	197	—	5,395	—	4½	—
	Devonport	,, 31	522	+ 28	1,3281	+ 491	5	—
	Dudley—Stourbridge..	,, 31	909	+116	24,387	+ 2,493	18⅝	—
	Gateshead	,, 31	940	+ 86	25,855	+ 4 213	10⅝	+ ¾
	Gravesend—Northfleet	,, 31	264	—	6,757	—	3½	—
	Greenock—Pt. Glasgow	,, 31	657	+ 82	16,106	+ 1,464	7½	—
	Hartlepool	,, 31	820	— 9	7,829	+ 419	6½	+2
	Kidderminster	,, 31	142	— 3	3,791	+ 205	4½	—
	Merthyr	,, 31	199	+ 11	5,907	— 230	3	—
	Middleton	,, 31	372	+ 74	9,617	+ 1,073	8½	—
	Oldham—Ashton ..	,, 31	578	+ 24	17,172	+ 1,4 9	8	—
	Peterborough	,, 31	166	—	4,301	—	—	—
	Poole	,, 31	823	+ 12	8,598	+ 1,342	8½	—
	Potteries	,, 31	1,658	+131	46,804	+ 2,784	28½	—
	Rothesay..	,, 31	366	+121	4,160	+ 1,471	2½	—
	Sheerness	,, 29	92	—	1,532	—	2½	—
	Southport	,, 31	358	+ 20	8,940	+ 1,783	6½	—

* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open. *
B.E.T. Co.	South Staffordshire ..	July 31	973	+241	25,719	+ 2,280	21½ —
	Swansea	,, 31	585	+ 98	15,199	+ 1,111	5½ —
	Taunton	,, 31	70	+ 1	1,727	— 137	1½ +1½
	Tynemouth	,, 31	434	— 13	8,990	+ 862	3½ —
	Weston-super-Mare..	,, 29	230	— 26	2,840	— 262	2½ +2½
	Wolverhampton Dist.	,, 31	403	+ 95	11 690	+ 6,845	10½ +8
	Wrexham	,, 31	148	—	2,458	—	— —
	Yorks. Woollen Dist. ..	,, 31	534	—	7,218	—	6 —
	Cardiff	Aug. 8	2,596	+470	37,922	+12,816	14 —
	Chatham & District Co.	July 30	617	+ 95	15,142	+11,864	7½ —
	Dover	Aug. 8	342	— 18	6,856	+ 114	3 —
	Dublin	,, 7	5,846	+185	34,483	+ 5,980	46 —
	East Ham	,, 8	990	+351	—	—	5 + ½
	Glasgow	,, 8	13,997	+271	133,506	+15,908	65 +10
	Hull	,, 8	2,097	—310	34,733	+ 1,706	11 + 1
	Ilkeston	,, 5	254	—	2,608	—	4 —
	Isle of Thanet	,, 8	2,309	+259	19,080	— 187	10½ —
	Leeds	,, 8	6,760	+342	108,758	+ 6,477	41 —
	Liverpool	,, 1	10,700	— 50	307,266	+11,031	101 +2½
	Manchester	,, 8	13,149	+7233	224,895	+146,642	72 —
	Newcastle	,, 8	3,746	+627	—	—	17 —
	Portsmouth	,, 8	3,019	+248	—	—	29 —
	Salford	,, 10	4,066	+1975	71,796	+22,318	30 —
	Southampton	,, 6	1,396	+117	—	—	9 —
	Sunderland	,, 2	1,546	+ 68	22,177	+ 736	20 +3
	Central London Railway	,, 8	6,115	—744	38,952	— 479	6 —
	City and S. London Ry.	,, 9	2,353	— 333	14,872	— 1,402	6½ —
	Dublin and Lucan Rlwy.	,, 9	191	+ 9	865	+ 60	6⅔ —
	Liverpool Overhead Ry.	,, 9	1,961	+164	10,581	+ 667	6⅞ —

THE DEVELOPMENT AND USE OF THE SMALL ELECTRIC MOTOR.

A well-illustrated series of articles, by F. M. Kimball, has been running through the last four numbers of the *Engineering Magazine*. To the electrical engineer the chief interest lies in the pictures, which are reproductions of photographs from actual examples of motor-driven machinery.

Many of the applications shown are well known to everyone who has had much experience with motor driving, but some possess features of novelty and suggestiveness. Machine tools figure largely among the examples chosen—lathes, boring, and drilling machines and shapers forming a not inconsiderable portion. As regards the powers taken by such machines, the author points out that this must vary largely with the class of work done, and the following list is given to represent the powers required under average conditions. If heavy tools and air-hardened steels are used, and production pushed to the limit of the tools, from three to four times these powers may be required.

Lathes	22 to 24 in.	require a	2-H.P. motor.
„	30 to 36 in.	„	3-H.P. „
„	48 to 54 in.	„	5-H.P. „
„	60 to 72 in.	„	7½-H.P. „
Boring mills,	48 in. swing	„	5-H.P. „
„	72 in. „	„	7½-H.P. „
„	96 in. „	„	10-H.P. „
„	16 ft. „	„	15-H.P. „
Planers, single head,	26 by 26	„	5-H.P. „
„ double head,	30 by 30	„	10-H.P. „
„ „	36 by 36		
„ „	48 by 48	„	15 H.P. „
„ „	54 by 54		
„ „	60 by 60	„	20-H.P. „
Drill presses,	20 in.	require a	2-H.P motor.
„ „	24 in.		
„ „	36 in.	„	a 3-H.P. „
„ „	40 in.		
„ „	50 in.	„	a 5-H.P. „
„ „	60 in.		

An Ingersoll-Sergeant compressor is shown driven by a motor through spur gearing. The compressor is double acting, and has two heavy fly-wheels, one of which is toothed to gear with the motor pinion. With sufficient fly-wheel storage, this forms a satisfactory method of driving, bnt not otherwise, as the strains are too severe on the gear and the motor.

The illustration of chain-hoist drive is interesting. Here the motor and controller are fixed to the same carriage as is the chain pulley block, which it drives through spur and worm gearing. A solenoid brake pulley is carried on the outer end of the motor spindle. The operations of starting and reversing are effected by hanging ropes.

A very neat and compact arrangement is shown in connection with the driving of a shaper. The arrangement is equally applicable to a lathe or any tool driven by a stepped cone. A 2-H.P motor running at 1,200 r.p.m. is back-geared by means of a spur wheel and pinion with a 5 to 1 ratio. The end of the second motion-shaft carries a four-step cone, and the whole thing being self-contained is inverted and fixed to the ceiling above the machine tool, which it drives by means of a belt. The driving of wood-working machinery claims four illustrations, but nothing exceptional is shown; the powers given for average work may, however, be interesting:—

A direct connected buzz planer, running at 4,000 r.p.m, requires a	5 H.P. motor.
A 24-in. cylinder planer, running at 3,725 r.p.m., will require for dry stock	7½ „
And for unseasoned rough lumber	15 „
Irregular double header moulders require per head	1½ to 2½ H.P.
A four-sided sticking machine, of average size ...	10 H.P
An 8-in. circular rip saw, on heavy work	1½ to 2 H.P.
A 12-in. cut-off or rip saw	3 H.P.
An 18-in „	5 H.P.
An ordinary band saw will require	2½ H.P.
An ordinary jig saw will require	1 H.P.

The above figures assume the machines to be in good condition and adjustment.

Several illustrations of motor-driven printing machinery, including linotypes, are shown, also shipyard machinery, fans, &c. One very interesting photo is of a 3-H.P. slow speed motor, mounted and geared to a 50-in. sluice valve. The advantages of operating large hydraulic or gas valves from a distance are great. A 50-in. valve will take five or six men 20 minutes to open or close it, to say nothing of the time required to get to the spot in an emergency. An electric motor will do the same work in less than three minutes.

The author goes fully and clearly into the technical and commercial problems involved, and the articles will be of value to machinery users generally.

MECHANICAL DRAUGHT.

Mechanical draught appears to be making greater progress in America than it does here. A very useful paper on the subject by Mr. Still, of Detroit, appears in the *Journal of the Western Society of Engineers*. He starts out with a statement of the three chief factors which control the economy of the fan draught:—

1. Less air is required per pound of coal.
2. Cheaper coal can be used.
3. Less heat is required to produce the draught.

As regards the first of these factors, there is the fact that ordinary draught requires usually a ratio of air and coal, of 24 : 1, whereas fan draught will enable the ratio to be reduced to 18 : 1, thus securing a direct saving of the heat that would otherwise be carried off in the extra 6 lbs.

No. 2 factor is well known as represented at times by a reduction of the cost of coal by one half, as to which, however, it must not be forgotten that as mechanical draught installations increase in number the cost of cheap coal will approach more closely than it now does to the cost of better coal, coal being cheap because it is small and often dirty, rather than because its calorific capacity is so abnormally low.

The third factor is pretty clearly established. If a fire has a temperature of 2,460° and the chimney temperature is 460°, then one-sixth the fuel has gone to produce draught. Chimney temperatures are often 500°, and even over 600°. To drive a fan requires not 16 per cent. of the heat produced, but only about 1 per cent., so that if a comparatively small reduction can be made in chimney temperature, there will be heat enough saved to drive the fan.

But all these factors must stand lower at times than a fourth, to wit, the ability to make such draught as is needed. Fog or bad direction of wind combined occasionally with an extra demand for power, may all be met by a fan draught. An increased chimney draught can only be secured by raising the temperature in the chimney, and probably this can least be done, when most required.

In working out an example the author takes the horse-power-hour to require 33,305 B.Th.U., whence he deduces about 33 lbs. of steam per horse-power-hour, and 3½ lbs. of coal.

With a flue gas temperature of 500°, and an outside temperature of 62°, the maximum draught for a 150 ft. chimney will be $p = h(d - d')$, or $150 \times (\cdot076097 - \cdot041414)$, or 1 in. water gauge.

Chimney friction is about ¼ lb. per square foot, or, say, 0·05 in. W.G. for a 6 ft. diameter stack, leaving a net draught of 0·95 in. W.G. To produce this pressure a column of air of external temperature 62° must be 68 5 ft. high, or

$$H = h\frac{d - d'}{d} = 150\left(\frac{\cdot076 - \cdot014}{\cdot076}\right).$$

The velocity of flow due to this head is $v = \sqrt{2gH} = 66{\cdot}37$ ft. per second draught velocity, and the area of the stack being 28·27 ft., the weight of the moved gas will be $66{\cdot}37 \times 28{\cdot}27 \times \cdot0761 = 142{\cdot}8$ lbs. The temperature required to effect this movement is 500°—62° = 438° F., which, multiplied by 142·8, and by the average specific heat of 0·2375, gives 14,850 B.Th.U., or 11½ million foot-pounds to do work which only amounts to 9,855 foot-pounds, so that as a heat engine the chimney has an efficiency of only $\frac{8}{100}$ of 1 per cent.

By using a fan instead, and assuming efficiency of engine and boiler at 7 per cent., of fan 40 per cent., and deducting 20 per cent. for friction, there is found 2½ per cent. efficiency. This is 26½ times the efficiency of the chimney.

Though a fan will often absorb less than 1 per cent. of the main engine power, it is usual to guarantee it not to absorb 2 per cent. Then, with a plant of 1,000 H.P., less than 20 H.P. would drive the fan.

In adding economisers the draught must be increased, or the coal cannot be burned. Hence follows the practice that an apparatus to save heat demands a hotter chimney. In Lancashire they get over the trouble by using chimneys of 200 or even 250 ft. But with a fan, the friction of the economisers is easily got over.

Less air is required with a fan draught because a thicker fire can be carried, and there is better combustion and less burning into holes and excess of air at these holes. Similarly, inferior coal can be burned, and a grate surface otherwise insufficient to do its work, can be made to do its work.

Coming to first cost, it is said that for plants of 1,000 H.P. the cost of a fan installation is less than one-fourth the cost of a chimney.

A single fan installation costs less than 40 per cent. of a chimney, and a double fan plant and a short stack less than 50 per cent., one fan being in reserve.

Smaller boiler plant also will serve without any excessive forcing, for a new plant on the old system must necessarily be schemed out to allow for periods of bad draught and be too large for its duty for over 90 per cent. of its time.

Experience has also shown that the better draught is reducing the smoke nuisance; many Detroit manufacturers having had to suffer expensive lawsuits because of smoke nuisance, and others are to follow. It is only apparently in London that Americans are allowed to plaster the sky with soot. At home they are fined and exposed to lawsuits.

The author states that up to a velocity of 110 ft. per second of fan periphery the efficiency increases and then falls off rapidly.

Little is known of fan performance, but it is usual and safe to assume that the resistance of furnace and flues is about equal to 25 per cent. reduction of fan discharge, *i.e.*, to a restriction of the area of discharge.

Rules are then given for proportioning fans.

Dampers are recommended to be cut up into a frame of louvres worked simultaneously, in place of one large, heavy plate.

Fan casing should not be less than $\frac{3}{16}$ in., or it may buckle, but No. 14 plate can be used for blades. Overhung wheels are not recommended, though often easier to apply.

The stack should never be carried on the housing of the fan, but on channels or columns from the floor. An automatic speed regulator is recommended to work by the pressure of steam so as to maintain the fan at proper speed.

In the discussion on the paper, allusion was made to the common plan of using higher chimneys on big power plants than on small plants, an obvious error on the side of the small design, for it is certain that if a high chimney is necessary in one case, it must be in the other. The draught in each case ought to be the same. Why then use different chimneys? Of course, the true reason is the practical difficulty of building so high a chimney on a narrow base, and thus it is that for small powers a fan is really more a necessity than it is for big plants. One speaker advocated smoke washing, as apparently the only satisfactory way to get rid of black smoke. Possibly washing would get rid of sulphur, but it is not necessary to employ it for soot. Why not use enough fire-brick?

A question arose as to whether a chimney giving, say, a draught of 1 in., would be an aid to a fan in producing a draught of 1½ in. Mr. Still says the chimney would be an obstruction to the fan. We think this decision is open to question, that is, if the chimney has sufficient area. It seems to us that two appliances in series should give an effect equal to the sum of their separate effects. The fan simply adds velocity to an already flowing stream. But no doubt, in case of a restricted chimney area, it might easily happen that a better result would be obtained by reducing the chimney height.

ELECTRIC ROCK DRILLS.

By T. CAMPBELL FUTERS.

Electric rock drills, in spite of opposition, are gradually making headway, and there is no doubt but that in time, as their advantages become known, and machines are more strongly built to withstand the rough usage to which they are subject, they will supersede the air drill altogether.

So far the great complaint is that they require excessive repairs as compared with air drills, owing to their somewhat delicate construction, necessitated by having to keep the machine as light and compact as possible, which limits the strength and wearing surface of the mechanism for converting the rotary motion of the motor into that of reciprocating for the drill. Were it possible to drill hard rocks with a rotary instead of percussive action there would not be the same difficulty experienced with the mechanism. Electric rotary drills for coal are simple, compact machines, driven direct by the motor with a single reduction gear, which gives no trouble, and holes can be drilled at the rate of a foot per minute. The only rotary drill which will drill hard rocks is the "diamond," but it is not suitable for mining or quarrying purposes, and is only used for prospecting.

The *Engineering and Mining Journal* for June 27th last contains an interesting article, comparing the electric with the compressed air or steam drill, and expresses a hope that "the electric drill may become a practical success in mining," of which there need be no question, the electric drill having come, and come to stay.

The first attempt to bring out an electrical percussion drill was made by Messrs. Siemens & Halske about 1879, and it was of the solenoid type, which seemed particularly suitable for a reciprocating motion, but was subsequently abandoned, chiefly on account of the heating of the solenoids and other electrical and magnetic difficulties; and further, from its construction it could not be very efficient, though probably much more so than the air machine. The next type was that in which the power is transmitted from a small motor by a flexible shaft. Visitors to the recent Colliery Exhibition had an opportunity of seeing the Gardner drill at work, whilst Messrs. Siemens & Halske also exhibited a drill, these being two of the most successful machines of this type. More recent inventions—as the Locke—have succeeded in mounting the motor upon the drill frame, which is the point to be aimed at, as it gets rid of the objection to the flexible shaft, and the motor is not quite so much exposed to the wet and dirt of the mine, as when standing about on the floor.

In the Siemens-Halske drill, the power is transmitted from the motor through the flexible shaft and mitre-wheels to a crankshaft, which drives a frame containing two springs, between which the drill piston is held. On moving this frame backwards and forwards slowly, the piston also moves as if rigidly attached to it, but by moving it rapidly the piston with the drill attached is thrown out at each end, and actually travels more than twice the stroke of the crank. The crankshaft is fitted with a small fly-wheel, which absorbs any irregular strains and prevents shocks to the gearing.

In the Gardner drill, the power is transmitted in a similar manner to a crankshaft, the crank of which works in a special shaped slot in a crosshead, so that a quarter of a revolution strikes the blow, the next half withdraws the drill, at the same time slightly turning it, and during the last quarter of the revolution the drill remains stationary; on the opposite end of the crankshaft is also a fly-wheel, which absorbs energy during the last quarter and gives it out during the next, and thus overcomes any tendency of the quick forward and slow return reciprocation of the crosshead to impart any irregularity to the rotation of the gearing. The drill is connected to the crosshead through buffer springs, and cannot strike a rigid blow.

The mechanism in both types is simple, the number of parts few, and they compare very favourably in this respect with any air drill. The largest Gardner drill requires a 2-H.P. motor, strikes 550 blows per minute, and weighs—drill and motor together—540 lbs, which is, probably, 100 lbs. less than the weight of an air drill to do the same work.

In the Locke drill the motor drives direct—through gearing—the crank axle, which is connected to the drill with a helical spring, and the speed of the motor is so adjusted that the drill strikes the blow synchronous to the *backward* stroke of the crank. This principle will be easily understood if one takes a piece of elastic with a small weight attached, and makes it spring up and down, when it will be found that at a certain rate, the hand and weight will approach each other, and the weight may be made to strike the floor while the hand is rising. The idea is a novel one, but will require a certain adjustment of speed and carefully tempered springs.

So far electric rock drills appear to have been left to American enterprise, and with the exception of the Siemens-Halske, which is really a German machine, there are none British manufacture, which seems a pity, as there is plenty of room for a good substantial British-made drill.

The great advantage of the electric drill is in its great saving of power as compared with the air drill. "An ordinary 3-in. air drill," says the above-mentioned *Journal*, "requires about 15 H.P., the ordinary electric drill on the market from 2 to 4 H.P., although it is not fair to draw a comparison between the two on this basis, for the reason that the *air drill does a great deal more work in the same time than the electric drill*, as there is much more power behind it; . . . . [but] it does not do enough more, to warrant the expenditure of 15 H.P. as against 2 H.P. if other conditions are equal." (The italics are the writer's.) The statement that the air drill does *more* work may be questioned; it is true it may strike a heavier blow, but the number of blows are not so many, an ordinary air drill striking about 300 blows per minute, whereas the electric drill will strike from 400 to 600.

Supporters of the air drill, however, claim that the exhaust from such a machine is a great aid to ventilation. This is rubbish! and no mining engineer—at least, in this country—would depend in the slightest upon air carried into the workings in this way to ventilate them; and upon this point the article previously quoted says:—"The air drill as a factor in ventilation may or may not be of value, according to conditions. In the first place, with a single stage compressor the *liability to combustion* of the oils used in lubrication (unless care is taken to condense all resulting gases with the moisture by means of an air receiver inter-cooler) will occasionally render the air actually *poisonous*. . . . . Again, the fetish of 'ventilation' is a *standing excuse* for leaking valves and pipe-lines such as are commonly seen underground." (The italics are the writer's.) So that "compressed air," as well as "electricity," is not without its dangers; but with the latter there would not be the same excuse for the careless waste of energy which "represents a considerable portion of the work done by a compressor at a large mine."

A letter on this subject, published in the same *Journal*, by Mr. Lawrence, who complained that "the expense of keeping electric "drills in repair was too heavy," says:—"From my experience, to date, with electric drills, I have failed, as yet, to find one which can replace the air drill for every day use in metalliferous mining." But have the electric drills had fair play? Probably the secret of much of the trouble—one might say most—is explained by another quotation from the article before mentioned, which says:—"When the air drill was first introduced, the old-fashioned miner did his best to kill it. Even to-day, try to introduce a new air drill into a mine and attempt to make a test between it and the machine already established in use, and you will find *how difficult it is to get fair treatment* for the new device." (The italics are the writer's.) "Ask the foreman to make a month's trial . . . . and you will find that in nine cases out of ten the men will 'knock the stuffing' out of the machine to which they are not accustomed—and which, for that *one* reason, they do not want to have introduced into the mine." This is perfectly true, and managers would do well before condemning an electric drill to be quite certain that it is the fault of the machine, and not that of the man in charge of it.

In conclusion, the following comparative results obtained in Germany between a Siemens-Halske electric percussion drill, and a pneumatic drill, may be of interest:—*

	Pneumatic drill.	Electric drill.
Work done in bore hole:—		
In cubic inches per minute...	2·75	3·0
In foot-lbs. per minute	11,664	12,960
Consumption of power in generator—distance between generator and motor being from 1,100 to 2,200 yds.:—		
In horse-power	10	1·7
Foot-lbs. per minute...	324,000	54,000
Total efficiency of the installation	36 %	24 %

ELECTRIC TRAMWAY MATTERS.

The following letter was addressed by the Board of Trade on the 29th ult. to the engineers and managers of electrical tramways in the United Kingdom:—

"I am directed by the Board of Trade to state that they desire to draw attention to the following criticisms which have been offered by their inspecting officers of railways and their electrical adviser

* *Vide* "Electricity in Mines," Rock Drills. Messrs. Siemens Bros. & Co., Ltd., London.

on certain points relating to the construction and equipment of electric cars for tramways and light railways laid on public roads:—

1. *Folding Steps.*—The efficiency of the life-guard is often impaired by the steps, which are liable to strike a person falling in front of the car before the life-guard can come into action. It is suggested, therefore, that the steps should be so designed as to fold up, and that they should invariably be folded at the front end of the car.

2. *Reversed Staircases.*—These staircases have the disadvantage of limiting the view of the motorman and of restricting his movements.

3. *Tringer Life-guard.*—The distance between the hanging gate and the life-guard proper should be about 3 ft., in order to allow time for the guard to drop before it meets the object to be picked up. In some cases the distance has been only 1 ft. 10 in., which is not enough to make the guard effective.

4. *Trolley Ropes.*—Several accidents have been caused by the slack of trolley ropes, and by the handling of trolley ropes by passengers. On many tramways the trolley ropes are kept tied up, and in some, no rope is used. For centre-running trolleys, or for swivel trolleys with a small reach, spring winches are useful for taking up the slack and for preventing the trolley from jumping. For swivel trolleys with a wide reach, the slack may be taken by providing a weight like a sash weight at the end of the rope, and putting this into an upright pipe with a bell mouth. The "nursing" of the trolley by the conductor is an admission of defective adjustment of the overhead work.

5. *Adjustable Stop on Trolley Standard.*—On many tramways it has been found practicable to adjust the screw stop so as to limit the rise of the boom if the trolley leaves the wire. It is desirable to adjust the height of the trolley wire and guard wires so that advantage may be taken of this limitation, to prevent damage to overhead work. Where there is no adjustable stop, the rise of the boom may be prevented by limiting the play of the trolley rope, except in the case of swivel trolleys with considerable reach.

6. *Trolley Heads.*—Several cases of injury to passengers by falling trolley heads have occurred. Although it is very desirable that, in the event of a trolley head catching in a switch or other overhead "trap," the head should become detached rather than that the boom should be pulled out or the standard broken, care should be taken that the boom is long enough to ensure that the trolley head may drop clear in the wake of the car.

7. *Trolley Booms.*—Several accidents have occurred through the pulling out of trolley booms. The attachment by pinching up a split casting, appears to be unsatisfactory, since insulating material is used, and a tight grip cannot be ensured. A half sleeve with four bolts or some other attachment is preferable.

8. *Breakage of Trolley Standards.*—When a trolley head catches, and neither the head nor the boom gives way, serious injury to passengers has been caused by the breaking or tearing up of the standard. Overhead "traps" should be avoided as much as possible. Anchoring of trolley wires in bracket construction should be avoided by anchoring in a vertical plane to a standard on the bracket, or if the bracket needs anchoring, that should be anchored and not the trolley wire.

The Board would be glad to learn whether you or the body which you represent concur in the foregoing criticisms, and will be prepared to take steps to meet them as regards new cars, and as far as practicable, with regard to cars now in use or under construction. Should you not be able to concur on any point, the Board will be glad to be furnished with any observations that you may desire to offer on the matters in question.—I am, your obedient servant,

HERBERT JEKYLL.

Board of Trade (Railway Dept.),
Whitehall Gardens, London, S.W.

ELECTRIC RAILWAYS IN EUROPE.

THE PROMOTION OF THE SUSPENDED SYSTEM.

THE increase in the use of electric traction as a means of communication in Germany has induced the War Office authorities to make certain additions to the military transport regulations for the general guidance of the army. Among these amplifications, the most important is the rule that on electrically-worked railways (tramway) with an overhead supply of current, military wagons loaded on ordinary railways must be provided with a protecting deck or cover, composed of insulating material, so that the iron parts of the vehicles are safeguarded from direct contact with a falling wire.

In Switzerland, where electricity as a motive power has become of considerable importance in connection with the operation of mountain railways, and where the Government is proceeding in a gradual manner to nationalise the ordinary steam railways, it has now been thought necessary to ascertain whether it is desirable to take steps to transform the latter to electric traction at an early date. The interest manifested in the subject throughout the country is illustrated by the conference which has just been held at Berne, and which was attended by representatives of the State railways, the private railway companies, engine builders, electrical firms and others. The object of the conference was to discuss the question as to whether electric traction should be introduced on all the railways in Switzerland. As might be expected, definite action was not taken, but a committee was appointed to investigate the subject and submit a report at the end of 12 months, or present proposals relating to the adoption of a suitable system of working. In addition to making a study of the question, the committee will conduct practical tests, and a considerable sum of money has been placed at its disposal for this purpose. The general director of the Swiss Railway Department has been elected chairman of the Committee, with the manager of a large electrical company as the deputy chairman.

A further step in connection with the contemplated transformation of the Swedish State Railways to electric traction has been taken by the administrative authorities, who have recommended the execution of the scheme by the utilisation of the numerous waterfalls and deposits of peat existing in the country. The Department of Communications has approved the proposal, and now recommends a trial of the various systems of electric locomotion, at an estimated cost of £21,000, by the construction of an experimental track for the use of competitors, who will be able to procure a supply of water-power free of charge. Among the companies which have offered to give a demonstration of their individual systems of electric traction without payment may be mentioned the Siemens-Schuckert Works Co., the Allgemeine Elektricitäts Gesellschaft, of Berlin, the Oerlikon Engineering Works and the Westinghouse Electric Co., of the United States, but not a single British company has asked for permission to participate in the competition.

The construction of the track of the full gauge electric railway in the suburbs of Berlin between the Potsdam railway station and Gross Lichterfelde is practically completed, and experimental runs of the trains are at present taking place. The conversion of this particular section of line was suggested as a result of the trials which were made for two years on the Wannsee Railway, near Berlin, and which did not lead to any definite conclusions being drawn as to the merits of electric traction, this being probably due to the conditions under which the electric trains were worked, sandwich fashion, in conjunction with steam locomotive trains. On the present occasion, however, no such difficulty will arise, as the State railway authorities are evidently determined to give the system a trial on their own account, and the work was entrusted to the Union Electricity Co., of Berlin. As in the case of the elevated electric railway in the German capital, and the Wannsee Railway, the current is supplied to the trains of the Potsdam-Lichterfelde line by means of a third rail placed in the middle of the track, and carried on insulated iron arms at some distance from the bed of the track, the return part of the circuit being formed by the ordinary rails in the usual way. Each train is composed of two or three cars, each car being equipped with two motors, and the total carrying capacity of a train is 210 passengers. It will be noticed that this equipment differs from that in use on the Berlin elevated electric railway, where the trains are composed of three cars, only the first and third being motor-cars.

The suspended electric railway on the Langen system is attracting considerable attention in Germany, where it is promoted by the Continental Co. for Electrical Enterprises, of Nuremberg. As the latter is desirous of obtaining a concession for the construction of a line according to this method in Berlin, between Gesundbrunnen and Rixdorf, the Minister for the Interior recently commissioned Herr Grave and Dr. Haselau to make an inspection of the representative railway at Elberfeld, and these gentlemen are reported to have expressed themselves in approval of the working of the line. In addition to this scheme, which relates to a railway to cross Berlin from north to south, the company has applied to the Minister for Agriculture with a view to powers being granted for the establishment of a suspended railway between Berlin and the intended park for the people at Grunewald. A third project is on foot for the Berlin district of Schoneberg, the municipal authorities of which have offered to pay the company £150 for the elaboration of a definite scheme.

The German capital does not stand alone in the prominence that is now being given to the suspended system. At Hamburg the Continental Company for Electrical Enterprises has now laid before the Senate and the city authorities a definite scheme which is a competitor with that submitted some time ago for an elevated railway on behalf of the Hamburg Tramway Co., the Siemens and Halske Co., and others. It is estimated that the cost of construction and equipment of the suspended line would amount to £1,750,000, and the railway would be completed in five years. The scheme provides for the formation of a company with a share capital of £500,000, whilst the balance of £1,250,000 is to be raised by the issue of bonds. It is said that arrangements have already been concluded between the Continental company and a banking syndicate headed by the North German Bank, for the emission of the bonds in two series of £625,000 each. The first series would have a preference claim, and for the second a Hamburg State guarantee is desired, the State to participate in the annual profits of the new company. It is claimed that the present scheme would be less expensive to carry out to the extent of £1,500,000 as compared with the elevated railway project, but the tramway company now states that this is a misrepresentation of the facts, and that the suspended line would be more costly than the Siemens plan. In support of this assertion the Hamburg tramway company alleges that the expenditure on the Elberfeld line was three times the amount of the estimates. Thus the matter stands at present, and a keen contest for the concession may be expected.

A scheme for a suspended railway is also being promoted for the Rhenish-Westphalian district; but it is uncertain whether the proposal emanates from the Continental Company of Nuremberg, as it is reported to be promoted by a number of prominent industrialists of good position. The idea is to form a company for the execution of the undertaking, although no estimate of the cost is forthcoming at present. It is proposed to commence the railway at the Massene dam near Unna, where a large power station would be built, and to continue it *viâ* Dortmund, Lutgen-Dortmund, Langen-

dreer, Bochum, Wattenscheid, Essen and Mulheim on the Ruhr to Duisburg. A branch line from the Massene dam, *vid* Königsborn, to Bergcamen, is also contemplated.

In conclusion, it may be mentioned that the preliminary investigations for the establishment of electrical working on the mountain section Landeck-Bludenz of the Arlberg railway have so far proceeded that the Austrian Minister for Railways will in a short time invite electrical companies to submit schemes for the carrying out of the work. It is expected that a decision will be arrived at in the autumn.

MUNICIPAL v. COMPANY LIGHTING IN VIENNA.

The events which commenced in Vienna about a year ago, and which are being continued at the present moment, afford a striking example of what may be expected in London, to some extent in any case, if the County Council should succeed in the attempt made in its Bill of the current session to become what would practically be the electric lighting authority for this great city, and also be successful in its endeavour to be the underground railway authority. It is astonishing that the hostility to private enterprises should only assert itself for the first time, and manifest its existence in the policy of grab-all or oppose-all when these undertakings have already shown themselves to be financially successful, or are tending in that direction. In this respect the London County Council finds a ready counterpart in the attitude of the Vienna municipal authorities. The latter first commenced with the Electric Tramway Construction and Operation Co., an enterprise which was formed in recent years to build and work electric tramways in the Austrian capital. Unfortunately for the company the agreement with the Vienna Town Council was loosely worded, and the Council, taking advantage of the position of affairs, obtained possession of the tramways after an exceedingly brief existence as an independent undertaking, and the shareholders have no reason to be thankful for the treatment to which they were subjected owing to the faulty clauses in the agreement. Encouraged by this success, the Council proceeded to erect and equip a municipal lighting and power station for the supply of private consumers and the working of the tramways, and subsequently to consider whether it should not begin to control the whole of the electric lighting trade in Vienna.

At the present time there are three supply companies operating in Vienna under concessions which will expire at the end of 1939. These are the General Austrian Electricity Co., which has alternating plant having a possible output of 16,000 H.P.; the International Electricity Co. with direct-current machinery capable of producing 15,000 H.P.; and the Vienna Electricity Co., whose alternating plant represents 3,000 H.P. These totals make an aggregate of 34,000 H.P. as compared with a station equipment of 9,000 H.P. in the case of that portion of the municipal combined works that is devoted solely to the supply of electricity for lighting purposes. The company stations have been in operation for several years, whilst the municipal enterprise was started less than two years ago, but not one of the four works has all its plant in use at any one time. When the concessions were first granted to the companies, agreements were entered into between them and the Town Council, and no objections were raised at the time to the reservation to the Council of the right of giving or refusing consent to the laying of cables in the streets as occasion might arise. When, however, the Council proceeded to build a municipal generating station, it at once changed its tactics. The applications made by the companies for permission to extend the network of mains were either ignored or refused, and it was discovered that an apparently harmless reservation was a formidable weapon in the hands of an authority about to become a competitor. Hampered in this manner, the companies instituted legal proceedings in order to show that the action of the Town Council was unjustifiable, and that it constituted a violation of the terms of the concession, and whilst two of the companies claimed over £40,000 damages, the third reserved its right to lodge a claim for compensation at a later date.

The action of the companies induced the municipal authority, pending a decision being arrived at by the Courts, to enter into negotiations with a view to a settlement of the dispute, and in July, 1902, a provisional understanding was come to whereby the companies were permitted to lay a total additional length of cable amounting to approximately seven miles, and a condition was made in favour of "loyal competition" between the municipal and the company stations. On this basis the legal proceedings were suspended at their then existing stage, in the hope of the provisional arrangement being converted into a definite agreement; but as all endeavours made in this direction have been unsuccessful, the action will now take its normal course.

It appears that during the negotiations the companies made considerable efforts to conciliate the Town Council. They expressed their readiness to abstain from making fresh connections for three years, provided that they were permitted, on the expiration of that period, to utilise their present plant to its fullest capacity during the remainder of the concession, that is to say, by being freely able to extend their cables. As against this reasonable request the Town Council actually proposed that the companies should permanently restrict their services to the existing lamp and motor connections, thus suggesting that the plant which is at present lying idle should never have an opportunity of refunding the capital expenditure incurred in purchasing it, and that the company should allow of the transfer of 250,000 glow lamps from their distributors to the municipal mains! Naturally enough, this preposterous proposal was declined.

The failure of the negotiations and the resumption of legal proceedings have now had the result, as decided upon by the Town Council in the second week in March, of the inauguration of a war of competition between the municipal works and the company stations. As announced by the Council, the contest is to take place in the sharpest form. On the one hand the managers of the municipal supply works have been given full powers to reduce the charges for supply in order to divert the customers of the companies, whilst on the other the public is appealed to for support on the ground of "local patriotism," and is informed that the town proposes to conduct the fight in an "honourable and loyal" manner. This announcement may perhaps be partly intended to appease the indignation of the public at the increase in the fares charged on the tramways, which under municipal ownership have not yielded the results that were anticipated; and even the combined lighting and power station is said to be worked in an expensive manner. The companies do not fear the effects of the cutting competition of the municipal authority, as the contest will mainly lie in attempts to divert consumers, but as each reduction on one side will be met by a similar lowering on the other side, it is merely a question as to which has the largest banking account, pending, of course, the decision of the Law Courts in regard to the cable question. The Municipal Council contemplates a war of destruction, and the poor ratepayer will be called upon to provide the money to pay the piper without being asked to call the tune.

Since the above was written, the London County Council Bill has fallen through for the present session, and the supply companies in Vienna have been successful in arranging terms with the Town Council. The new agreement provides that no fresh house connections shall be made by the companies until the end of 1905, except under existing contracts, and that supply to new consumers may be resumed at the beginning of 1906, although extensions of cables for this purpose will be restricted to exceedingly narrow limits which are defined in the agreement. Even under these circumstances, the companies, whose network serves the most important houses and districts in Vienna, expect to make a decent living.

REPORT ON MUNICIPAL TRADING.

The Joint Select Committee of the House of Lords and the House of Commons, which was appointed in May and June last, "To consider and report as to the principles which should govern powers given by Bills and Provisional Orders to municipal and other local authorities for industrial enterprise within or without the area of their jurisdiction," issued its report on Wednesday last week. The report reads as follows:—

The Select Committee appointed to join with a Committee of the House of Lords to consider and report as to the principles which should govern powers given by Bills and Provisional Orders to Municipal and other Local Authorities for Industrial Enterprise within or without the Area of their Jurisdiction;—Have considered the matters to them referred and have agreed to the following report:—

1. The present Committee may be regarded as continuing the inquiry held by the Joint Committee on Municipal Trading appointed in 1900, an identical reference having been made in each case.

2. The evidence taken by the former Committee was of a general character, beginning with a detailed examination of the limits and restrictions now imposed upon the undertakings of local authorities by different Departments of State, by the authorities of both Houses entrusted with the regulation of private business, and by the practice of select committees. The former Committee then proceeded to some consideration of the general arguments advanced by advocates and opponents of municipal trading.

3. In consequence, however, of the great extent of ground to be covered, and the complexity of the subject, that Committee were unable to make any report on the merits, but confined themselves to a recommendation of re-appointment in the next Session.

4. The present Committee, in view of the fact that they were not appointed until after Whitsuntide, and were unable to hold their first meeting before June 15th, decided to take a different course.

5. The Committee felt that any attempt to survey the general subject of Municipal Trading could only have led to a second postponement of the inquiry, as it would have been impossible for them in the short time available before the close of the Session (when the existence of every Committee is terminated) to issue a Report upon the whole subject.

They agreed, therefore, to devote their attention to one or more distinct aspects of the question, passing by others until Parliament should be pleased to direct further inquiry.

6. The first branch of the subject with which the Committee decided to deal was that of municipal accounts, with regard both to the form in which they are prepared, the systems under which they are audited, and the right of access to them possessed by the ratepayers. The evidence taken has been mainly directed to these questions.

7. Whatever view may be taken of the proper limits, if any, which can be set to municipal trading, it is clearly important that wherever it exists, ratepayers should be not less fully and continuously informed of the success or failure of each undertaking than if they were shareholders in an ordinary trading company.

8. In a large number of cases this is undoubtedly done. But

there is in some instances evidence to a contrary effect, and in view of the ever-increasing number and magnitude of municipal undertakings, it is most desirable that a high and uniform standard of account-keeping should prevail throughout the country.

9. The Committee are doubtful whether it would be possible to prescribe a standard form of keeping accounts for all municipal or other local authorities, having regard to the varying conditions existing in different districts. But they recommend that the Local Government Departments should invite the Institute of Chartered Accountants, the Incorporated Society of Accountants and Auditors, and the Institute of Municipal Treasurers and Accountants of England and Wales, and the Society of Accountants in Edinburgh, and the Scottish Institute of Accountants in Glasgow, to confer and report upon the matter.

10. The Committee have directed full attention to the question of audit.

11. The Committee recommend that a uniform system of audit should be applied to all the major local authorities, viz., the Councils of counties, cities, towns, burghs, and of urban districts.

12. At present Municipal Corporations in England and Wales, with a few exceptions, are only subject as regards audit to the provisions of the Municipal Corporations Act, 1882, by which one auditor, who must be a member of the Town Council, is nominated by the Mayor, and two, who cannot be members of the Town Council, are elected by the ratepayers.

13. The evidence shows that no effective system of audit is thus supplied. The elective auditors are poorly paid, or are unpaid altogether, little interest is taken in their election, and although in some cases they are able to lay a finger on a particular irregularity, it is not clear that they could not make the same discovery in the capacity of active ratepayers. No complete or continuous audit is ever attempted by them.

14. All County Councils, the London Borough Councils, and Urban District Councils are subject to the Local Government Board audit. This audit is carried out by District Auditors, who, as a rule, are not accountants, and are not, in the opinion of the Committee, properly qualified to discharge the duties which should devolve upon them. By special local Acts the Corporations of Tunbridge Wells, Bournemouth and Southend-on-Sea, must, and the Corporation of Folkestone may, adopt the Local Government Board system of audit. The duties of the auditors seem to be practically confined to certification of figures, and to the noting of illegal items of expenditure.

15. To apply this system of audit to Municipal Corporations would arouse strenuous opposition from them, and the course may be considered impracticable; but in addition to this the fact that district auditors are not accountants seems to unfit them as a class for the continuous and complicated task of auditing the accounts of what are really great commercial businesses.

16. The Committee accordingly recommend that—

(*a*) The existing systems of audit applicable to corporations, county councils, and urban district councils in England and Wales, be abolished.

(*b*) Auditors, being members of the Institute of Chartered Accountants or of the Incorporated Society of Accountants and Auditors, should be appointed by the three classes of local authorities just mentioned.

(*c*) In every case the appointment should be subject to the approval of the Local Government Board, after hearing any objections made by ratepayers, and the auditor, who should hold office for a term not exceeding five years, should be eligible for re-appointment and should not be dismissed by the local authority without the sanction of the Board.

(*d*) In the event of any disagreement between the local authority and the auditor as to his remuneration, the Local Government Board should have power to determine the matter.

(*e*) The Scots practice of appointing auditors from a distance, in preference to local men, to audit the accounts of small burghs should in similar cases be adopted in England.

17. The Committee are of opinion that it should be made clear by statute or regulation that the duties of those entrusted with the audit of local accounts are not confined to mere certification of figures. They, therefore, further recommend that—

(*a*) The auditor should have the right of access to all such papers, books, accounts, vouchers, sanctions for loans, and so forth, as are necessary for his examination and certificate.

(*b*) He should be entitled to require from officers of the authority such information and explanation as may be necessary for the performance of his duties.

(*c*) He should certify—

(1.) that he has found the accounts in order, or otherwise, as the case may be;

(2.) that separate accounts of all trading undertakings have been kept, and that every charge which each ought to bear has been duly debited;

(3.) that in his opinion the accounts issued present a true and correct view of the transactions and results of trading (if any) for the period under investigation;

(4) that due provision has been made out of Revenue for the repayment of Loans, that all items of receipts and expenditure and all known liabilities have been brought into account, and that the value of all assets has in all cases been fairly stated.

18. Auditors should be required to express an opinion upon the necessity of reserve funds, of amounts set aside to meet depreciation and obsolescence of plant in addition to the statutory sinking funds, and of the adequacy of such amounts.

19. The auditor should also be required to present a report to the Local Authority. Such report should include observations upon any matters as to which he has not been satisfied, or which in his judgment called for special notice, particularly with regard to the value of any assets taken into account.

20. The Local Authority should forward to the Local Government Board both the detailed accounts and the report of the auditor made upon them. It should be the duty of the auditor to report independently to the Board any case in which an authority declines to carry out any recommendation made by him.

21. A printed copy of the accounts, with the certificate and report of the auditor thereon, should be supplied by the Local Authority to any ratepayer at a reasonable charge.

22. After careful consideration, the Committee are of opinion that in view of the thoroughness of the proposed audit, powers of surcharge and disallowance could be altogether dispensed with in the case of the major local authorities.

23. Those powers could not, it is believed, be applied to Municipal Corporations in view of the strong objection expressed by them; and it is doubted whether their retention in the case of other authorities would compensate for the loss of uniformity which would result.

24. The power of disallowance, applying as it does only to illegal expenditure, and not to unwise undertakings and enterprises, does not afford any real safeguard to the ratepayers whose interests are affected.

25. With a continuous, vigilant and thoroughly efficient system of inspection and audit, the surest guarantee to the ratepayers against extravagance is to be found in the deterrent effect of public exposure, in addition to the existing legal remedies.

26. The dispensing power possessed by the Local Government Board under the Local Authorities (Expenses) Act, 1887, throws on the department an amount of work often out of proportion to the importance of the issue involved.

27. The Committee suggest that in view of the large changes recommended by them it might be advisable to create a new body, in the form of a Board of Commissioners of Local Audit, in some respects analogous to the Railway Commission. This body could be entrusted with the powers which the Committee recommend in their Report should be vested in the Local Government Board.

28. The Committee recommend that if in the case of Scotland it is thought desirable that the existing statutory audit of accounts of County and Borough Councils should be maintained, at any rate the system of audit for the five large cities, which is at present regulated by private Acts, should be assimilated to that which is recommended for the major local authorities in England.

29. The Committee are of opinion that it would be advisable to continue investigation into other branches of the subject of Municipal Trading in a future Session of Parliament.

July 23rd, 1903.

THE NECESSITY FOR PRECISION OF STATEMENT IN TECHNICAL WORK.

By H. M. HOBART.

(*Concluded from page* 243.)

As to question No. 8, although in well-informed quarters it is perfectly well recognised that there are still great drawbacks to the use of 220-volt lamps, their use is still only too often recommended on the short-sighted assumption that there will thereby be effected the clear gain incident to the less section of copper required in the cables for a given percentage line drop. This may, however, be easily offset by the fact that manufacturers have never yet placed on the market a 220-volt lamp, which, for the same life up to a given degree of deterioration, will burn with less than 15 per cent. more watts per C.P. than a 110-volt lamp. This could, in many cases, result in its use being *less* economical. It is, of course, simply a question of cost of cables and cost of production of power. For cases where the lamps are used on an alternating current system, and the comparison is very close, other considerations, namely, the periodicity supplied and the candle-power of the individual lamps, should not be overlooked in deciding.

For—and this relates to the 9th question—no broad statement can at present be made as to the minimum suitable frequency for incandescent lighting. A long, thin filament will respond more quickly, as regards its degree of incandescence, to the cyclic fluctuation in the current strength, than a short, thick filament, since it has a larger radiating surface per unit of energy consumed. Hence, while 32-C.P. 110-volt lamps might give perfect satisfaction at 15 cycles per second, 8-C.P. 220-volt lamps might be very unsatisfactory at 30 cycles per second. The wave form of the circuit should also have some influence on the result. At the 1901 Convention of the National Electric Light Association (see *Proceedings*, ditto, p. 132), Mr. Wilcox stated "that the incandescent lamp has proven satisfactory with all reductions of frequency down to 25 cycles per second, and can even be adapted for as low as 15 cycles."

—	Nernst lamps.	Incandescent vacuum lamps.	Induction motors.	Continuous current motors.	Motor-generators in sub-stations.	Rotary converters in sub-stations.
High voltage	.. ..	High consumption and low outlay for cables	The larger the output the higher the voltage for which an induction motor may be economically wound.	Low-speed motors may be either high or low voltage. Large high-speed motors better for moderately low voltage.	The design of the polyphase motor is better for high speed and low frequency. The design of the generator, if for continuous current, is better the lower the speed; and if the speed must be high, a moderately low voltage may, in large units, also contribute to a better design.	Designs for rotary converters for a given output are generally better the lower the voltage, the lower the speed and the lower the frequency.
Low voltage	.. ..	Low consumption. High outlay for cables				
High speed (r.p.m.) ..	.. ..	.. ..		Should preferably be low speed.		
Low speed (r.p.m.) ..	.. ..	.. ..				
High frequency (cycles per second)	High economy ..	Satisfactory for all candle-powers and voltages	Should preferably be for high speed and low frequency.	.. ..		
Low frequency (cycles per second)	Low economy ..	More satisfactory for high candle-powers and low voltage		.. ..		
Steam turbines as prime movers	Adapted for supplying either type, perhaps more especially the Nernst.		Not so cheap or so good as for lower periodicities.	Only on the secondaries of motor-generator sub-stations.	On account of inadaptability of steam turbines to very low frequency, motor-generators are to be preferred to rotary converters in the sub-stations.	
Piston steam engines as prime movers	Either type for high frequency. Incandescent vacuum lamp for low frequency.		Preferably high speed and low frequency.	Preferably very low speed.	Motor-generators should be employed when frequency is high or speed of generating set low, or both.	Rotary converters are permissible when frequency is low and speed of generating set high.
Gas engines as prime movers	Nernst lamp has low economy at low periodicity, hence for gas engines.	Might preclude high-voltage low candle-power lamps.			Motor-generators are permissible with low frequency and high speed of generating set and liberal fly-wheel capacity.	Rotary converters are very undesirable when the prime movers are gas engines.
Rotary converters in sub-stations ..	.. ..	.. ..	.. ..	.. ..		
Motor-generators in sub-stations ..	.. ..	.. ..	.. ..	.. ..		
Continuous current motors ..	.. ..	.. .. ..	Continuous current motors inherently better and cheaper for low-speed work. Induction motors inherently better and cheaper for high-speed work, if not handicapped by high frequency.			
Induction motors	.. ..	.. .. ..				
Incandescent vacuum lamps	Nernst lamps extremely long life at high frequency, but very short life at very low frequency, where, however, incandescent vacuum lamps of high voltage and low candle-power are to be avoided.					
Nernst lamps ..						

Although there are but few really good data as to the most favourable periodicities and the limiting periodicities of the Nernst lamp and the incandescent lamp, it looks as if, so far as relates to alternating current circuits, the former would, on the whole, prove better adapted at high frequencies; hence, in a general way, they may perhaps tend to accompany the introduction of the turbine, but for exceedingly low frequencies, and hence with gas engines and with plants employing direct driving from low speed engines, vacuum incandescent lamps of suitably chosen candle-power and voltage should give the best results. But, of course, the use of frequency transformers would often be justified, and would make either lamp equally useful with any prime mover. The fact, however, that such connections between the most suitable type for the consumer's lamp and motor and the type of prime mover may be so easily shown to exist, is not without interest and importance.

In the accompanying chart an attempt has been made to embody these conclusions in tabular form, but this necessitates, to a certain degree, that very brevity of statement, the danger of which it has been one of the main purposes of this article to emphasise. However, with a recognition of this limitation, it is thought that the table may aid the comprehension of the inter-relations between these different factors in power and lighting schemes.

The chart, at any rate, illustrates rather strikingly the increased complexity of questions arising for consideration with relation to new projects, as compared with the state of the art 10 years ago, when the question generally arising related merely to the relative merits of continuous and alternating current systems, and was not complicated by so many secondary factors.

The writer would not maintain that the few considerations touched upon in connection with these subjects are by any means thoroughly handled. They merely serve to sustain his contention that the conditions relating to a given case can hardly be too carefully weighed before going ahead with a scheme. Nor should the final decision as to the plant to be employed rest solely upon first cost and economy in operation. Those responsible for the steam or gas plant will inevitably be less alive to the electrical difficulties arising from the very features which are to them of chief importance, and *vice versâ*. Thus, if, for instance, large low speed gas engines *must*, because of their great economy, be used for driving parallel-operated polyphase generators, which latter supply sub-stations, it becomes more than ever incumbent upon the electrical engineer to study the conditions closely, and in all matters coming under his control, to adopt plant calculated to give satisfaction under these conditions. In this particular case he would endeavour to have large fly-wheels provided, and to employ low frequency and motor-generators in the sub-stations.

THE RIGHT TO CUT OFF THE SUPPLY.

One of the most important privileges conferred upon the "undertakers" who supply electricity to the public is that which enables them to discontinue the supply, in a case where the consumer refuses to pay rent or otherwise misconducts himself. This right may be exercised in a variety of circumstances. Thus it is provided by Sec. 21 of the Electric Lighting Act, 1882, that if any local authority, company, or person neglect to pay any charge for electricity,

Gas engines (as prime movers).	Piston steam engines (as prime movers).	Steam turbines (as prime movers).	Low frequency (cycles per second).	High frequency (cycles per second).	Low speed (r.p.m.).	High speed (r.p.m.).
.. ..	.. ..	For large continuous-current dynamos, the design for moderately low voltage is less difficult.	.. .. ..	.. ..	For large continuous current machines.	
.. ..	.. ..		.. .. ..	.. ..	.. ..	Moderately low voltage leads to better design of continuous current machines in the case of large units, which must run at high speed.
Permissible for very low frequency alternators.	Excellent for direct-driven alternating-current dynamos.	The speed should be as low as practicable.	Excellent for alternators and induction motors.	High speed, especially desirable when high frequency is unavoidable.		
Excellent for continuous current dynamos and also when commutator voltage is high.			Low frequency especially desirable when low speed is unavoidable.	Very undesirable from the standpoint both of the alternating current generators and of the motors.		
Should not be employed.	Should be of high speed type.	Frequency should not be so low as to entail a very bad design of alternator in virtue of a very small number of poles.				
Should preferably be of high speed type						

or any other sum due from them to the undertakers in respect of the supply of electricity to such local authority, &c., the undertakers may cut off such supply, and for that purpose may cut or disconnect any electric line or other work through which electricity may be supplied, and may, until such charge or other sum, together with any expenses incurred by the undertakers in cutting off such supply of electricity as aforesaid, is fully paid, but no longer, discontinue the supply of electricity to such local authority, &c.

The period when the meter rent is to become due and payable is usually settled by the contract between the parties. Thus the undertakers may require payment of their accounts quarterly, monthly, or weekly.

The Electric Lighting (Clauses) Act, 1899, also makes provision for the cutting-off of supply in certain events. By Clause 27 (3) of the schedule to that Act, which is incorporated with nearly every provisional order, the undertakers may, after they have given a supply of energy in respect of any premises, by notice in writing, require the owner or occupier of those premises, within seven days after the date of the service of the notice, to give to them security for the payment of all monies which may become due to them in respect of the supply, in case the owner or occupier has not already given that security, or in case any security given has become invalid or insufficient; and in case any such owner or occupier fails to comply with the term of the notice, the undertakers may, if they think fit, discontinue to supply energy for the premises, so long as the failure continues.

There is one other event in which the undertakers may cut off the supply, and to state the circumstances, is to state the justice of the case.

Clause 27 (4) of the schedule to the Electric Lighting (Clauses) Act provides that if the owner or occupier of any premises uses any form of lamp or burner, or uses energy supplied to him by undertakers for any purposes, or deals with it in any manner, so as to interfere unduly or improperly with the efficient supply of energy to any other body or person by the undertakers, the undertakers may, if they think fit, discontinue to supply energy to those premises so long as the lamp or burner is so used, or the energy is so used or dealt with. The Act also provides that the undertakers are not to be compelled to give a supply of energy to any premises unless they are reasonably satisfied that the lines, fittings and apparatus therein are in good order and condition, and not calculated to affect injuriously the use of energy by the undertakers or by other persons.

Any expenses incurred in cutting off the supply of electricity may be recovered summarily as a civil debt; and, of course, it is competent for the undertakers, instead of bringing pressure to bear upon a defaulting consumer by cutting off, or threatening to cut off, his supply, to recover the amount due by summary process in a police court.

The right to cut off, and the threat to exercise this right, are, however, most effective remedies in the hands of the company, and so long as the consumer is not arbitrarily treated, there is no hardship upon him. The proper way to test the matter is to consider what would happen if the company were bound to go on giving a supply whether their lawful charges were paid or no. In that case it might be incumbent upon the undertakers to continue a supply until every little claim which they might have against the consumer were tested and enforced in a court of law. Unless, however, they exercise the power judiciously, they lay themselves open to unfavourable comments from the Bench; for they must go to Court if they wish to enforce payment. In a recent case which was heard by his Honour Judge Emden, it appeared that in the latter part of 1901 an installation of 14 16-c.p. lamps was put in a consumer's house. Of these six belonged to the supply company. The agreement stated that 2s. per quarter should be the rent of the meter if 20 8-c.p. lamps or their equivalent were used, to be increased to 3s. per quarter if over 20 8-c.p. lamps or their equivalent were used. It appeared that the consumer after some time, and without the consent of or notice to the company, changed his installation to three 16-c.p. lamps and 12 8-c.p. lamps. Upon doing this he refused for six quarters to pay more than 3s. a quarter meter rent, and eventually on May 19th his supply was cut off. In giving judgment for the consumer when he was sued by the company, his Honour Judge Emden thought proper to make the following observations:—"I cannot allow this case to pass without saying that it is impossible for a public corporation to carry on business if they abuse their powers in this way. Here we have a responsible gentleman, an officer who has been in her late Majesty's army, who has always paid his way; not a word can be said against him, and on a trivial claim for 6s. he is put to the disgrace of having his light cut off. The corporation has a monopoly; it is entrusted with great powers, but if it exercises them in such a way, it is unfitted to be entrusted with such powers." We confess that we do not altogether share the view so expressed by his Honour; but, at the same time, the case may act as a warning to supply companies not to exercise their powers in an arbitrary manner.

Bradford Lighting.—The Mayor of Bradford (Alderman Wade) on 7th inst. opened the new electricity generating station, known as No. 3 station, in Valley Road, Bradford. It is estimated that, when completed, the building and plant will represent an outlay of about £140,000. The scheme of the electricity department includes the extension of the present building now opened for the accommodation of five other engines, and when this is accomplished there will be provided a total horse-power of something like 20,000, whilst the total expenditure will come somewhere near a quarter of a million of money. There were present at the opening ceremony, in addition to the Mayor, the Mayoress and Miss Wade, Mr. C. E. Dowson (chairman of the Electricity Committee), several of the members of the Committee and Council, the town clerk (Mr. F. Stevens), Mr. R. A. Chattock (electrical engineer), &c. A luncheon followed at the Town Hall, at which the Mayor presided.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,456. "Improvements in the manufacture of incandescence electric lamps." H. Hogge and J. Barrolier. July 27th. (Complete). (Date applied for under Patents Act, 1901, April 8th, 1903, being date of application in France.)

16,469. "Electrical fog-signalling apparatus." O. R. St. J. Palmer. July 27th.

16,481. "Improvements in and connected with apparatus for electrically locking railway carriage doors." W. Walmsley. July 27th.

16,509. "Improved field magnet for electrical machines." T. A. Hearson. (Electricitäts-Gesellschaft Alioth, Switzerland). July 27th. (Complete).

16,511. "Improvements in electric hoist controllers." W. H. Scott. July 27th.

16,513. "Improvements in and relating to electrical fuses or cut-outs." W. R. Macdonald and G. E. Heyl-Dia. July 27th.

16,514. "Improvements in indicating devices for use with electrical fuses or cut-outs." W. R. Macdonald and G. E. Heyl-Dia. July 27th.

16,534. "Improvements in and relating to secondary galvanic batteries." M. Schneider and J. Beissbarth. July 28th.

16,594. "An improved process for making fireproof casings and covers for electric conductors." H. R. Romney. July 28th.

16,636. "Improvements in insulator brackets for telegraphic or telephonic purposes." C. H. Brandreth. July 29th.

16,661. "Improvements in and relating to electrical heating devices." M. H. Schoenberg and J. W. Edwards. July 29th. (Complete.)

16,711. "Insulators for electrical terminals." J. A. Davenport and A. F. Guy. July 30th.

16,740. "Improvements in time-limit electric circuit controllers." E. A. Carolan. (The General Electric Co., United States.) July 30th.

16,741. "Improvements in electric arc lamps." E. A. Carolan. (The General Electric Co., United States.) July 30th.

16,742. "Improvements in electric cut-outs or switches." E. A. Carolan. (The General Electric Co., United States.) July 30th.

16,744. "Improvements in controlling electric switches." E. A. Carolan. (The General Electric Co., United States.) July 30th.

16,745. "Improvements in controllers for electric motors." E. A. Carolan. (The General Electric Co., United States.) July 30th.

16,774. "Improvements in converting electric currents." G. H. Baillia. July 31st.

16,788. "Electric integrator." W. B. Day. July 31st.

16,806. "Improvements in electrical fuses, ceiling roses and wall plugs, and method of attaching metal terminals thereto." J. M. Douglas. July 31st. (Complete.)

16,809. "Improvements in or connected with holding devices for the collecting brushes of electrical machines." G. Breqer. (Electricitats Gesellschaft Alioth, Switzerland.) July 31st. (Complete.)

16,817. "Improvements in dynamo-electric machines of the class employing commutators." H. M. Hobart. July 31st.

16,830. "An improvement in connection with the trolley wheels of overhead driven electric vehicles." W. C. Dunne and L. Levitt. July 31st.

16,836. "Improvements in and connected with lamp-holders for electric incandescent lamps." F. Subatzus. July 31st.

16,853. "An improvement in flexible metallic tubing for armouring electrical conductors, and apparatus for its manufacture." W. H. K. Bowley. July 31st.

16,855. "Improvements in sparking plugs." A. K. Huntington. July 31st.

16,856. "Improvements in electrostatic methods of measuring electrical potential differences." E. W. Marchant and G. W. Worrall. August 1st.

16,878. "Improvements in and relating to printing telegraph instruments." C. M. Stiner. August 1st. (Complete.)

16,902. "Improvements in electrical fuses." E. N. Bray, F. R. Markham, F. E. Reiss, and Bray, Markham & Reiss, Ltd. August 1st.

16,907. "Improvements in controllers for electric motors." J. Bush. August 1st.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps),

2,065. "Improvements in or relating to driving gear for electrically-propelled vehicles." W. L. Wise. (Maschinenfabrik Oerlikon, Oerlikon, Switzerland.) Dated January 25th.

2,084. "Improvements in joints and joint-boxes for electrical conductors." G. Wilkinson. Dated January 27th.

2,125. "Improved electric measuring apparatus with movable spools." Dr. R. Franke. Dated January 27th.

2,159. "Improvements in and relating to electric fuses." C. E. C. Shawfield and E. P. Wetmore. Dated January 27th.

2,201. "Improvements in or connected with massage and electro-therapeutical apparatus." D. R. Paterson. Dated January 28th.

2,248. "Improvements in electric galvanic belts." H. H. Lake. (S. J. Spalding, U.S.A.) Dated January 28th.

2,264. "Improvements in electric insulating compounds for conductors and the like, and in the method of applying the same." British Thomson-Houston Co. (E. Thomson and J. G. Cailan, U.S.A.) Dated January 28th.

2,284. "Improved means for supporting and connecting electric lamps." H. H. Cooper. Dated January 28th.

2,310. "Improvements relating to electric telegraphy." A. Muirhead. Dated January 28th.

2,343. "Improvements in cooking stoves heated by oil, gas, or electricity." H. J. Yates and D. R. McNeill. Dated January 29th.

2,377. "Electric heating fabrics." J. M. C. Herrgott. Dated January 29th.

2,492. "Improvements in connections for concentric electric cables." J. R. P. Lunn. Dated January 30th.

2,498. "Improvements in casings for electrical conductors, gas and water pipes, and the like." J. D. Palmer. Dated January 30th.

2,520. "Improved means of connecting and disconnecting electric mains or cables in street boxes." S. E. Britton. Dated January 31st.

2,521. "An improved disconnecting box for electric mains, with means for rendering the same gas and waterproof." S. E. Britton. Dated January 31st.

2,552. "Improvements in electric couplings or terminals." E. Hardman. Dated January 31st.

2,584. "Improvements in rheostats or electrical resistances." A. B. Rigby and E. G. Scott. Dated January 31st.

2,587. "Improvements in electrodes for arc lamps." C. D. Abel. (Siemens and Halske Aktien-Gesellschaft, Berlin.) Dated January 31st.

2,659. "Improvements in and connected with resistance switches for electric circuits." G. Page. Dated February 1st.

2,666. "Improvements in brush-holders for dynamo-electric machines." British Thomson-Houston Co. (H. F. T. Erben, U.S.A.) Dated February 1st.

2,674. "Improvements in and connected with electric meters of the thermal type." M. P. Thomsen. Dated February 1st.

2,700. "Telephone exchange circuit." G. Lambert. Dated February 3rd.

2,701. "Improvements in telephone line jacks." G. Lambert. Dated February 3rd.

2,774. "Improvements in electrical switches." R. F. Hall. Dated February 4th.

2,816. "Electric battery." C. A. Allison. (W. C. Banks, U.S.A.) Dated February 4th.

2,820. "Improvements in apparatus for the electrolysis of water." P. Garuti and R. Pompili (trading as Garuti & Pompili). Dated February 4th.

2,825. "Improvements in time electric switches." H. J. Cogswell. Dated February 4th.

2,840. "Improvements in street lamps or lanterns for incandescent electric light." E. Stanley and British Prism Globe Electrical Co. Dated February 4th.

2,869. "Improvements in and relating to automatic fuse cut-outs and cut-ins." A. Vandam and T. H. Marsh. Dated February 4th.

2,984. "Improvements in apparatus for use in starting and controlling electric motors." A. H. Adams and J. T. Mould. Dated February 5th.

2,987. "Improved means for producing chlorates or perchlorates of the alkali metals." R. Threlfall and G. E. Wilson. Dated February 5th.

2,990. "Improvements connected with incandescent electric lamps." J. Swinburne and M. Solomon. Dated February 6th.

3,024. "Improvements relating to electric traction by the surface contact system." B. Cruvellier. Dated February 6th.

3,059. "Improvements in and connected with current collectors for electric vehicles." L. Lavagne and L. Bertrand. Dated February 6th.

3,061. "Improved automatic shunt coil core for arc lamps." A. E. Carter. Dated February 6th.

3,608. "Improved manufacture of strands for telegraph and telephone cables." Siemens Bros. & Co. (Siemens & Halske, Aktiengesellschaft, Berlin.) Dated February 12th.

3,610. "Improvements in electrically-propelled vehicles for single rail elevated railways." F. B. Behr. Dated February 12th.

3,157. "Improvements in arc lamps." H. T. Harrison and Improved Electric Glow Lamp Co. Dated February 12th.

3,165. "Improvements in and relating to multi-polar electrical dynamos or motors." D. Bergmann. Dated February 7th.

3,224. "Improvements in inter-communication telephone systems." L. Cerebotani and M. Baumer. Dated February 8th.

3,236. "Improvements in means for operating switches or points of railways or tramways." T. H. Bettney. Dated February 8th.

3,248. "Improvements in electric signal register and telephone systems." P. Jensen. (Yurgae Signalphone Manufacturing Co., U.S.A.) Dated February 8th.

3,259. "Improvements in mercury vapour electricity lamps." E. Schattner. Dated February 8th.

3,265. "An improved multi-tubular radiator especially applicable for motor carriages." A. Loyal. (Date applied for under Patents Acts, 1901, November 29th, 1901.) Dated February 8th.

3,279. "Improvements in conduits for electric cables and the like." J. Place and Sons, and W. H. Place. (Grant of Patent refused.) Dated February 10th.

3,336. "Improvements in electrical resistances." R. Hopfelt. Dated February 10th.

3,374. "An improved protective operating device for electric motors and like purposes." J. Y. Johnson. (Electric Controller & Supply Co., U.S.A.) Dated February 10th.

3,416. "Improvements in switches for electric light circuits and the like." J. Jones and J. Jones. Dated February 11th.

4,134. "Improved revoluble telephone mouthpiece." F. W. Moenninghoff. Dated February 18th.

4,180. "Improvements in electrical synchronism indicators." K. Edgcumbe, E. I. Everett, and F. Punga. Dated February 18th.

4,254. "Improvements in or relating to electric cells or batteries." H. H. Lake. (Soc. Anon. "Le Carbone.") Dated February 19th.

4,262. "Improvements in or relating to telegraph instruments." H. Cunningham. (E. Bing and H. Nevill.) Dated February 19th.

11,177. "Improvements in apparatus for opening and closing electric circuits." H. Hirst and C. F. Trippe. Dated May 15th.

11,423. "Improvements in electrical dam dredges." E. Chaquette. Dated May 17th.

11,489. "Improvements in starting devices for alternating-current induction motors." British Thomson-Houston Co., Ltd., and H. S. Meyer. Dated May 20th.

11,814. "Improvements in means for preventing commutator sparking in dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,820. "Improvements in or relating to systems of electrical connections for current measuring instruments." H. H. Lake. (General Electric Co.) Dated May 24th.

11,824. "Improvement relating to dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,827. "Improvements in magnetic clutches." H. H. Lake. (General Electric Co.) Dated May 24th.

11,828. "Improvements relating to dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,830. "Improvements in brush-holders for dynamo-electric machines." H. H. Lake. Dated May 24th.

11,834. "Improvements in electric condensers." H. H. Lake. (General Electric Co.) Dated May 24th.

11,836 "Improvements in or relating to commutator brushes and brush-holders for dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 24th.

11,841. "Improvements in apparatus for measuring the potential or strength of electric currents." H. H. Lake. (General Electric Co.) Dated May 24th.

11,843. "Improvements in fuses for electrical purposes." H. H. Lake. (General Electric Co.) Dated May 24th.

11,881. "Improvements in electric fire alarms." L. J. Abrahams. Dated May 24th.

11,972. "Improvements in electric accumulator plates." A. Fischer. Dated May 26th.

12,080. "Improvements relating to the field magnets of dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated May 27th.

12,158. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. Abel. (Siemens & Halske Aktiengesellschaft.) Dated May 28th.

12,218. "Improvements in or relating to electric ignition mechanism for internal combustion motors." J. J. H. Sturmey. (C. E. Duryea.) Dated May 29th.

12,517. "Improvements in multiplex telegraphy." G. L. Hogan. Dated June 2nd.

12,764. "Improvements relating to brush-holders for dynamo-electric machines and similar apparatus." H. H. Lake. (General Electric Co.) Dated June 4th.

13,255. "Improvements in electrical measuring instruments." A. C. Heap. Dated June 11th.

13,789. "An improved connecting rod for connecting telephones and telegraphic instruments to overhead conductors." C. Dietz. Dated June 17th.